A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

MAY, 1940.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

1329. Meson theory of nuclear forces. Part II. Theory of the deuteron. H. A. BETHE. *Phys. Rev.*, **57**, *pp.* 390–413, *March* 1, 1940.—With the nuclear forces as derived in Part I [see Abstract 923 (1940)], a theory of the deuteron is developed. It is satisfactory to regard the ground state as a combination of a ^3S and a $^3D_1$ state, both in the neutral and in the symmetrical theory; the next higher triplet state is probably $^3P_1$. On the neutral theory a cut-off distance of 0·32 to 0·40 of the range of the forces will fit the positions of singlet and triplet state, and calculations are carried out with two alternative ways of cutting off, assuming the potential inside r_0 either to be zero, or to retain the value it had at r_0. It is found that all physically significant quantities are practically independent of the method of cutting off. The wave function contains about 6·7% $^3D_1$ state, the rest being ^3S. This means that the sum of the magnetic moments of proton and neutron should be about 0·04 nuclear magneton greater than the deuteron moment, and this is just reconcilable with present experimental data. The calculated quadrupole moment of the deuteron is 2·70 or $2{\cdot}61 \times 10^{-27}$ cm^2., according to the two methods of cutting off; the sign is positive. Both sign and magnitude are in good agreement with experiment. The $^3P_1$ state is calculated and is shown to be unstable and to have no appreciable influence on the scattering of neutrons of moderate energy. A discussion of the symmetrical theory shows that the calculations for this theory give wholly unsatisfactory results, particularly for the cut-off distance, and even for an alternative way of cutting off. In spite of this, only the symmetrical theory gives a natural explanation of the β-decay and of the extra magnetic moments of neutron and proton. N. M. B.

1330. Separation of Zn isotopes by diffusion in the liquid phase. H. KORSCHING AND K. WIRTZ. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 3, [2 *pp.*], 1939.—The method of thermal diffusion in the Clusius separator tube was applied to an aqueous solution of $ZnSO_4$. The temperatures of the two walls were 15°C. and 80°C. respectively, and the length of the tube was 90 cm. A 0·4 *M* solution was used. After 48 hr. the concentration ratio ^{64}Zn : ^{66}Zn : ^{68}Zn was found to be 52·5 : 27·1 : 16·4 at the upper end of the tube and 48·5 : 28·3 : 18·1 at the lower end, whilst the normal value for the ratio is 51·4 : 26·9 : 17·4. G. G.

1331. Separation of isotopes. E. H. RIESENFELD. *Arkiv f. Kem. Min. och. Geologi, A*, **13**, 16, *pp.* 1–11, 1939. *In German.*—This paper describes a comparative investigation of the various methods available for the separation of isotopes. They can be divided into two classes—closed diffusion methods and open diffusion methods. The two methods are described in detail. The open diffusion method was found to have the following advantages: The experiment may be interrupted whenever it is found desirable; the number of units in the apparatus is reduced to half for the same degree of separation; a quicker interchange is obtained between the various diffusion units, and an approximately 7-fold increase in yield is obtained. G. G.

***1332. Separation of isotopes by thermal diffusion.** A. Bijl. *Ned. T. Natuurk.*, **7**, *pp.* 147–153, *March*, 1940.—This paper is a general review of the problem of the separation of isotopes by means of thermal diffusion. The theory underlying the method is discussed in some detail. This is followed by an account of the apparatus used, as well as of the results obtained. G. G.

1333. Electronic structure of zinc in condensed states. M. Satô. *Tohoku Univ., Sci. Reports*, **28**, *pp.* 143–196, *Oct.*, 1939. *Report No.* 461 *of the Research Inst. for Iron, Steel and Other Metals.*—From data previously reported [see Abstract 2186 (1939)] the energy states for valency electrons in the mass are found. From data on specific heat, heat of vaporization, surface tension, and heat of fusion it is deduced that: (1) Up to 950°C. Zn atoms when molten form groups of 4 in two ways, either $E_1 \rightleftarrows E_4$ resonance occurs, or $E_2 \rightleftarrows E_3$ bond with constant association and dissociation. (2) Each atom has 3 degrees of freedom in thermal vibration. (3) Fusion takes place first by the transition E_2; (4*s*, 4*p*), (4*s*, 4*d*); $^5F_2 \rightarrow {}^5F_1$ using up a small portion of energy, secondly the (E_2E_3) association becomes temporary instead of permanent, the main portion of latent heat being work of expansion against cohesion. At 950°C. the (E_1E_4) association becomes temporary. The effect of internal stress on thermal points, selective absorption of light, and velocity of solution in acid are also considered. D. R. H.

1334. Molecular structures of fluorobenzene and o-difluorobenzene by electron diffraction. H. Oosaka. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 31–36, *Jan.*, 1940.—The molecular structures of fluorobenzene and *o*-difluorobenzene have been investigated by the electron diffraction method. The C-F distances in these molecules have been determined as 1·34 ± 0·04 Å and 1·35 ± 0·03 Å, respectively. These distances are shorter than expected from the covalent radii of Pauling and Huggins. This shortening is discussed in terms of resonance among several valence-bond structures. The dipole moment of halogen-substituted benzenes is considered in relation to the carbon-halogen distances and the double bond character of the linkage. Author.

1335. Structure of phosphine and related hydrides. D. P. Stevenson. *J. Chem. Phys.*, **8**, *pp.* 285–287, *March*, 1940.—It is shown that Badger's rule [see Abstract 1389 (1934)] when applied to the frequencies of some hydrides gives values for the interatomic distances which are in agreement with values deduced from the moments of inertia of the hydrides and with values predicted from the covalent radius suggested for hydrogen, 0·315 Å. Using the value 1·415 Å for the P-H distance in PH_3 and a reliable spectroscopic value for one of the moments of inertia of the molecule one finds the bond angle to be 93°. Values are suggested for the bond angles and bond instances in a number of hydrides whose structures have not been experimentally determined. Author.

1336. Spectroscopic evidence for hydrogen bonds—SH, NH, and NH_2 compounds. W. Gordy and S. C. Stanford. *Am. Chem. Soc., J.*, **62**, *pp.* 497–505, *March*, 1940.—The association of the mercaptans with certain electron donor solvents was investigated by infra-red spectroscopy. Results indicate H-bonding between only certain solvents (pyridine, α-picoline, and dibenzylamine) and thiophenol, with the SH group donating the proton. There is evidence that thiophenol is not polymerized in the liquid state. The study included a number of amines having basicity constants about the same as or lower than that of aniline. All were found to be

V.4
194

associated through H-bonds except those for which steric hindrance would be expected to prevent the association. Each of the compounds was studied in an oxygenated solvent, *n*-butyl ether, in order to detect complex formation through NH → O bonds with the ether, and data as to polymerization or tendency to form complexes are given. N. M. B.

1337. Br-Br distance in dibromides of cis- and trans-stilbene. J. D. McCullough. *Am. Chem. Soc., J.*, **62**, *pp.* 480–482, *March*, 1940.—The Br-Br separations in the molecules of the crystalline stilbene dibromides have been measured by means of the radial distribution treatment of X-ray powder photographs. The separation was found to be 4·50 Å in the *meso* dibromide and 3·85 Å in the *dl* dibromide. In the former, all like groups are *trans* to each other, while in the latter the Br atoms are as close to each other as the van der Waals radius for bromine will permit. The results support the postulate of Young and Pressman, as yet unpublished, and are in agreement with the electric dipole moments found by Weissberger. Author.

1338. Method of molecular orbitals. C. A. Coulson and G. S. Rushbrooke. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 193–200, *April*, 1940.—It is shown that the usual molecular orbital treatment for the mobile electrons in unsaturated hydrocarbon molecules is not always satisfactory, since it does not yield a self-consistent field. The conditions under which the field is self-consistent are analysed, and are satisfied in many cases. [See Abstracts 887 and 3485 (1939) and following Abstract.] Authors.

1339. Calculation of energy in unsaturated hydrocarbon molecules. C. A. Coulson. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 201–203, *April*, 1940.—[See preceding Abstract.]

1340. Tenth Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, M. Guichard, O. Hönigschmid and R. Whytlaw-Gray. *Am. Chem. Soc., J.*, **62**, *pp.* 669–672, *March*, 1940. *Chem. Soc., J.*, *pp.* 475–478, *April*, 1940.—The changes proposed are H 1·0081 to 1·0080, Fe 55·84 to 55·85 and Lu 175·00 to 174·99. The separation of the isotopes of Cl by thermal diffusion, and the isotopic constitutions of Mo, Eu and Pb are discussed with reference to the atomic weights of these elements, confirming the present values. [See Abstract 1441 (1939).] C. A. S.

See also Abstracts 1381, 1514, 1523, 1537, 1556, 1561, 1574, 1597, 1618, 1636, 1646, 1654.

COLLOIDS.

1341. Variation of composition of inter-micellary liquid during ultra-filtration of colloidal liquid. A. Boutaric. *Ann. Soc. Sci. de Bruxelles*, **60**, *pp.* 31–36, *March* 9, 1940.—The variation in the composition of the inter-micellary fluid during the ultra-filtration of a colloidal liquid is discussed mathematically by the application of Donnan's theory of membrane equilibrium. J. S. G. T.

1342. Silicic acid as protective colloid for MnO_2 sols. F. Hazel. *J. Phys. Chem.*, **44**, *pp.* 422–427, *April*, 1940.—Silica sols increase the stability of colloidal MnO_2 toward NaCl, $BaCl_2$ and $Th(NO_3)_4$. The protective action has been explained on the basis of mutual adsorption. No protective action was observed with HNO_3 as the added electrolyte. Colloidal silicic acid is flocculated at low concentrations of Th-ions. The sol is recharged at concentrations of the order of 10^{-5} to 10^{-6} *M*. Neither SiO_2 sols nor MnO_2 sols yield an irregular series with Th-ions. Author.

1343. Nuclear gold sols. Part III. Lower limit of particle size. A. Baker and F. L. Usher. *Faraday Soc., Trans.*, **36**, *pp.* 549–557, *April*, 1940.—Previous work on the minimum size of gold nuclei is reviewed. Attempts to reduce the size of nuclei by the addition of adsorbable anions were unsuccessful. Progressive dilution of the reacting solutions over an extensive range resulted in the production of stable nuclei of less than one-tenth the size of the smallest hitherto believed to exist. These nuclei are of approximately the size of a unit cell of crystalline gold. The experimental results are in agreement with the view that the formation of colloidal particles from atoms or molecules is a continuous process governed by the same kinetic principles as are used to explain coagulation. The terms " nuclei " and " primary particles " have no significance apart from their use to describe the smallest particles that are stable or detectable under existing conditions. [For Part II see Abstract 298 (1940).] Authors.

1344. Asphaltic bitumen as colloid system. J. P. Pfeiffer and R. N. J. Saal. *J. Phys. Chem.*, **44**, *pp.* 139–149, *Feb.*, 1940.—Schematic representations are given of the colloid systems present in asphaltic bitumens. "Normal" bitumens consist of micelles which move through the heavy, oily maltene phase. The micelles consist of a nucleus of high-molecular-weight hydrocarbons predominantly aromatic in character, the molecular weight and aromatic nature diminishing away from the centre. When the system contains adequate resins the system is fully peptized and shows purely viscous flow except for any intramicellar elasticity. If there is a shortage of resins, as in blown bitumens, the micelles link together forming a gel structure in which case the system exhibits thixotropy and elasticity both inter and intramicellar. For various bitumens the molecular weight of the asphaltene micelles has been determined by Langmuir's monomolecular film method, and the proportion of the maltene fractions consisting of aromatic compounds and its molecular weight have been measured. The influence of the various constituents was ascertained by studying the properties of synthetic mixtures. The relative volumes of the two phases was determined, for bitumens with distinct gel structure, by separating some of the oily phase by absorbing the sweated oil in a porous powder and comparing its properties with those of the maltene fraction. J. B. W.

1345. Rheological properties of asphaltic bitumens. R. N. J. Saal and J. W. A. Labout. *J. Phys. Chem.*, **44**, *pp.* 149–165, *Feb.*, 1940.—The following rheological measurements were made on two quite different bitumens by means of a conicyclindric rotating viscometer :—(*a*) change in deformation with time under constant shearing stresses ; (*b*) degree of elastic recovery after various deformations ; (*c*) relaxation of internal stress with time after various deformations ; (*d*) recovery with time after deformation and partial relaxation of the stress ; (*e*) relaxation of internal stress with time after deformation and partial recovery. Results were in agreement with the properties deduced for a theoretical model representing the simplest form of a mixed gel-sol system, but the model did not account for more complicated treatment. J. B. W.

1346. Elastic recovery and plastic flow in raw rubber. L. R. G. Treloar. *Faraday Soc., Trans.*, **36**, *pp.* 538–549, *April*, 1940.—In considering existing information on the mechanical properties of raw rubber, it is not generally possible to distinguish between the effects of elastic and of plastic deformation. In the experiments described great care was taken to secure the complete removal of elastic strain, after stretching to various extensions at different temperatures. The plastic flow increased to a maximum with

V.4
194

increasing elongation and fell again at higher elongations, an effect attributed to the increase of crystallization with increasing extension. For rubber held extended for one hour at 25°C. the flow was never greater than 2% of the original extension, whilst for extensions greater than 440% or less than 130% it was negligibly small. Curves showing the decay of tension at constant extension, and the recovery of length after stretching, in conjunction with the observations on plastic flow, are interpreted in terms of a theory proposed by Busse, according to which the rubber molecules are held together at certain points by cohesional linkages of low energy, some of which are broken down during stretching. AUTHOR.

1347. X-ray studies of crystallite orientation in cellulose fibres. Part III. W. A. SISSON. *J. Phys. Chem.*, **44**, *pp.* 513–529, *April*, 1940.—Earlier investigations regarding the orienting properties of native cellulose in both natural fibres and in synthetic fibres made from bacterial cellulose membranes have been extended to hydrate cellulose in synthetic fibres produced from cellulose coagulated from various solutions. The hydrate cellulose crystallite possesses a major orienting tendency with reference to the *b*-axis, and a minor or selective orienting tendency with reference to the 101 plane. Orientation of these axes may be produced either by shrinkage or by elongation of the sample. Whenever there is a relative increase in dimension of a sample in one direction, the *b*-axes of the unit cell tend to orient parallel to that direction; if there is a relative decrease in dimension in one direction, the 101 planes are oriented perpendicular to that direction. The degree of orientation in each case is proportional to the relative change in dimensions of the sample. In films such as cellophane, the X-ray diagram shows a selective uniplanar orientation of the 101 plane if, upon drying, the swollen film is allowed to shrink only normal to the plane of the film. Likewise rayon fibres, especially viscose, if spun without tension, show a similar selective orientation with reference to the fibre surface. In both films and fibres, selective orientation of the 101 plane is destroyed by stretching, which produces a uniaxial orientation of the *b*-axis (axis of cellulose chains) parallel to the direction of stretching. [For Part II see Abstract 2508 (1936).] AUTHOR.

1348. Effect of air film in emulsification. I. S. HALL AND E. H. DAWSON. *Indust. and Engin. Chem.*, **32**, *pp.* 415–420, *March*, 1940.—The stability and homogeneity of oil-in-water emulsions of high-oil content have been found to be less when an air film adheres to the oil phase than when such a film is absent. This is true in both of the two common methods of emulsification studied. The emulsions are of the mayonnaise variety, made according to a formula similar to that used by the mayonnaise manufacturers with the exceptions that the egg yolk emulsifier is fresh, and that exceedingly large quantities of oil are emulsified by very small amounts of yolk. AUTHORS.

1349. Effect of phosphate buffers on electrical mobility of haemoglobin. M. H. GORIN, H. A. ABRAMSON AND L. S. MOYER. *Am. Chem. Soc., J.*, **62**, *pp.* 643–644, *March*, 1940.—Variations of the ionic strength of a buffer at constant pH can affect the electric mobility of a protein in two ways: (1) a change in ion atmosphere will occur, (2) a change in the charge of the protein might occur due to specific interaction with the ions of the buffer. It is shown that when both effects are taken into consideration in a way that has previously been applied to proteins in buffer systems containing only uni-univalent ions the recent data of Davis and Cohn on the electric mobility of haemoglobin in phosphate buffers are reasonably explained. [See Abstract 3853 (1939).] AUTHORS.

1350. Electrokinetic potentials of BaSO$_4$. R. G. RUYSSEN. *J. Phys. Chem.*, **44**, *pp.* 265–275, *March*, 1940.—The streaming potentials on precipitated and negatively charged BaSO$_4$ show a charge reversal by BaCl$_2$ solution; the ζ-potential–concentration curve is a typical one for the adsorption of a potential-determining ion. The adsorbed Ba ions are liberated and desorption of Ba ions takes place in a strong KCl solution ($M/10$). The positive potential curve displayed a great charge increase in 50% ethanolic solutions of BaCl$_2$ and Ba(NO$_3$)$_2$. The charge reversal of the negative BaSO$_4$ was also observed for KBrO$_3$ and KCl in 50% ethanol. AUTHOR.

1351. Action of ionizing radiations on electrophoretic mobility of colloid particles. J. A. CROWTHER, H. LIEBMANN AND R. JONES. *Phil. Mag.*, **29**, *pp.* 391–399, *April*, 1940.—Experiments with a series of Au sols of different particle size which were irradiated with γ-rays and homogeneous X-rays of two different wavelengths have given the following results:—(1) The electrophoretic mobility of the sols shows rhythmic increases and decreases with steadily increasing doses of radiation. (2) If the D_n is the dose required to bring the sol to the nth turning-point (maximum or minimum) of the curve relating dose with electrophoretic mobility, for a given sol the relation holds: D_n/k^n = constant. The value of k is independent of the particle size, the nature of the sol and the radiation employed within the limits of experimental error. (3) The quantity a^2D_n/k^n is approximately constant for sols of the same material, but decreases slowly with increase in the radius a. (4) The energy absorbed per unit volume of sol for the production of a given change in the electrophoretic mobility of the sol is 1·58 times greater for MoK-radiation than for SeK-radiation. For these radiations the number of quanta absorbed for a given change in the mobility is the same. There is not sufficient evidence to show whether this is a general rule for all wavelengths. AUTHORS.

1352. Intramolecular folding of polypeptide chains in relation to protein structure. H. NEURATH. *J. Phys. Chem.*, **44**, *pp.* 296–305, *March*, 1940.—The space requirements and orientation of amino acid residues in fully extended and folded polypeptide chains have been investigated with the use of scaled atomic models. Accommodation of the side chains, formed by the amino acid residues, may be readily brought about in fully extended polypeptide chains, chiefly owing to the fact that the side chains protrude alternately from the upper and lower surface of the plane formed by the main chain. This structure can account, almost quantitatively, for the observed film areas and properties of protein monolayers. Folding of polypeptide chains, in the manner suggested for α-keratin and supercontracted keratin, respectively, results in drastic changes in the orientation of the side chains. The data indicate that, unless unreasonable distortions of bond angles are assumed, these configurations are too condensed to permit residues, other than those of glycine and alanine, and H atoms to get into the positions called for by the C atoms of the hexagonal rings to which they are attached. From considerations of space requirements of amino-acid residues it follows also that the cyclol structure is too condensed to permit the accommodation of side chains. The significance of these considerations for the problem of protein structure is discussed. AUTHOR.

1353. Colloid aspects of milk technology. W. L. DAVIES. *Current Science*, **9**, *pp.* 61–63, *Feb.*, 1940.

See also Abstracts 1381, 1382, 1519, 1630.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1354. Stability of crystal lattices. Part I. M. BORN. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 160–172, *April*, 1940.—The stability of lattices is discussed from the standpoint of the method of small vibrations. It is shown that it is not necessary to determine the whole vibrational spectrum, but only its long-wave part. The stability conditions are nothing but the positive definiteness of the macroscopic deformation energy, and can be expressed in the form of inequalities for the elastic constants. A new method is explained for calculating these as lattice sums, and this method is applied to the three monatomic lattice types assuming central forces. In this way one obtains a simple explanation of the fact that the face-centred lattice is stable, whereas the simple lattice is always unstable and the body-centred also except for small exponents of the attractive forces. It is indicated that this method might be used for an improvement of the present rather unsatisfactory theory of strength. [See following Abstract.]
AUTHOR.

1355. Stability of crystal lattices. Part II. R. D. MISRA. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 173–182, *April*, 1940.—On the assumption that the potential energy of the 3 cubic lattices of the Bravais type consists of two terms, an attractive one proportional to r^{-m} and a repulsive one proportional to r^{-n}, $n > m$, stability conditions are expressed in the form that two functions of the number n should be monotonically increasing. These functions have been calculated numerically for $n = 4$ to 15, and are represented as curves with the abscissa n. The result is that the face-centred lattice is completely stable, that the body-centred lattice is unstable for large exponents in the law of force, and that the simple lattice is always unstable—in complete agreement with the results of Part I [see preceding Abstract].
AUTHOR.

1356. Binary alloy system Ag-Te. V. KOERN. *Univ. Tartuensis (Dorpatensis), Acta et Comm. A*, **35**, 4, [45 *pp.*]. 1940. *In German.*—Ingots are synthesized from Kahlbaum Ag sheet and Te rods in a quartz tube with refractory stopper, and temperatures measured by a Ni-nichrome couple, by use of a galvanometer with hand-operated stylus and paper drum, an absolute accuracy of ±3°C. is attained. The liquidus is found to fall gently from 960°C. (m.pt. of Ag) to a eutectic at 860° and 12 atomic % Te, then to rise to a sharp peak at 958° for Ag_2Te; it then falls steeply to another eutectic at 348°C. and 63 atomic % Te, and finally rises to the m.pt. of Te at 449°C. The author also concludes that there is an $\alpha \rightleftarrows \beta$ change point in Ag_2Te at about 135°C., but even drastic quenching from 1 000°C. fails to suppress this entirely; the low temperature modification appears from powder photographs to be orthorhombic with $a = 13{\cdot}0$, $b = 12{\cdot}7$, $c = 12{\cdot}2$ Å. There is also evidence for the existence of $Ag_{12}Te$, which changes over to Ag_2Te at 443°C.; this compound also exists in two modifications, with transformation point at 408°. With Cr K-radiation, powder photographs show it to be hexagonal with $a = 13{\cdot}43$, $c = 8{\cdot}45$ Å, $n = 3$, there are 57 atoms in the unit cell of space group $D_{6h}^1 - C6/mmm$ or $D_6^1 - C62$. Eight micrographs, three Laue lattices of Ag_2Te and a set of powder photographs of the system are included.
D. R. H.

1357. Crystal chemistry of rare-earth compounds. D. Giuşča and I. Popescu. *Soc. Roumaine de Physique, Bull.*, **40**, 73, *pp*. 13–24, 1939.—The mono- and di-germanates and titanates of La, Pr, Nd, Sm and Y have been prepared by fusion of the constituent oxides in the required proportions with or without addition of an alkaline germanate or titanate. The results are generally parallel with those obtained with the corresponding silicates, but a new rhombic form of La_2 and Nd_2GeO_5 was obtained. Sm_2 and $Y_2Ti_2O_7$ give cubic crystals isomorphous with koppite and $Ca_2Nb_2O_7$, which probably explains the composition of the pyrochlores as mixed crystals. C. A. S.

1358. Properties and structure of caesium hexachlorogermanate. A. W. Laubengayer, O. B. Billings and A. E. Newkirk. *Am. Chem. Soc., J.*, **62**, *pp*. 546–548, *March*, 1940.—The formation of chlorogermanic acid and its salts has been studied under a variety of conditions. Evidence for the formation of negatively charged complex ions, presumably $GeCl_6^-$, when $GeCl_4$ is dissolved in concentrated HCl has been obtained by migration experiments. Cs_2GeCl_6 has been prepared and its properties and crystal structure have been studied. It has a face-centred cubic lattice. Authors.

1359. Variable structures and continuous scattering of X-rays from layer silicate lattices. S. B. Hendricks. *Phys. Rev.*, **57**, *pp*. 448–454, *March* 1, 1940.—Crystals of some micas and related compounds having "layer" lattices show pronounced continuous scattering of X-rays together with normal interference maxima. Continuous scattering is explained as arising from destruction of the lattice periodicity normal to the perfect cleavage of these types of substances. This is a result of translation of some layers along the b axis and parallel to the cleavage by $nb_0/3$, where b_0 is the unique lattice periodicity and n is an integer. Various crystals differ in their degree of randomness and four general types are recognized: (1) no irregularity, (2) most elements of the crystal mosaic have a few irregular layers, (3) some elements have a regular sequence of layers while others have many irregular layers, (4) all elements have many irregular layers which leads to a small pseudo unit of structure. The phenomenon is illustrated by reproductions of photographs. Author.

1360. Polymorphism in iodides of choline esters. C. Stora. *Comptes Rendus*, **210**, *pp*. 107–109, *Jan*. 15, 1940.—The following X-ray and optical data are given for iodides of choline laurate, palmitate and stearate. Forms (A) of the laurate and palmitate are monoclinic while all the (B) forms appear to be triclinic.

		a (Å)	b (Å)	c (Å)	$d \sin \beta$ (Å)	Density	$n\alpha$	$n\beta$	$n\gamma$
Laurate	(B)	15·56	5·74	—	24·02	—	—	—	—
	(A)	9·54	8·01	29·34	27·72	1·25	1·54	1·549	—
Palmitate	(A)	—	7·98	34·42	32·5	1·204	1·54	1·548	—
	(B)	5·74	9·55	—	28·3	1·143	—	1·544	1·583
Stearate	B	5·76	9·58	30·54	30·40	1·116	—	1·545	1·58

The above evidence of dimorphism in these compounds is discussed in relation to their molecular structures. J. I.

1361. Solid solutions of H_2O_2 and H_2O. P. A. Giguère and O. Maass. *Canad. J. of Research, B*, **18**, *pp*. 66–73, *Feb*., 1940.—An attempt has been made to determine the exact composition of the first crystals that separate

V.4
194

out on freezing solutions of H_2O_2 and H_2O of various concentrations. Special care was taken to ensure complete removal of any liquid wetting the solid phase. In all cases the crystals were found to contain both components and in porportions usually different from those in the mother-liquor. Owing to the limitations of the experimental method used, the results are only approximate, but they afford ample evidence for the existence of solid solutions. The possibility of H_2O_2 forming solid solutions with water is discussed from the standpoint of the crystal structure of both components. AUTHORS.

1362. Crystal boundaries in tin. B. CHALMERS. *Roy. Soc., Proc. A*, **175**, *pp.* 100–110, *March* 28, 1940.—A new technique is described for preparing specimens of tin consisting of two crystals of controlled orientation of such size and shape that a tension can be applied transversely to the boundary. It is found that the temperature at which the crystals separate under tension is below the melting-point of the crystalline material, and that the difference is independent of the angle between the crystal axes of the two crystals and of impurity providing this does not exceed about 0·02%. The mechanism of boundary formation is considered, a distinction being drawn between two types of boundary described as " columnar " and " segregational ". The structure of the boundary is discussed in the light of the new experimental evidence, which favours a " transitional lattice " rather than an " amorphous layer " theory. AUTHOR.

***1363. Apparatus for determining the orientation of crystals by X-rays.** F. E. HAWORTH. *Rev. Sci. Instruments*, **11**, *pp.* 88–91, *March*, 1940.—An apparatus has been developed in which orientations of single crystals, and the crystals in polycrystalline materials, can be studied with X-rays by rotating the specimen and moving a photographic film at the same time. The apparatus combines the best features of both the Weissenberg goniometer and that of Dawson by having the X-ray beam incident along the axis of a cylindrical film and thus recording a Debye-Scherrer circle instead of a layer line. The motion of the film and rotation of the specimen may be continuous or in steps. For motion in steps an automatic mechanism is used which exposes the film for a length of time controlled by an electric clock, and then moves the film and rotates the specimen an amount controlled by a revolution counter geared to the motor. When the cylindrical film is flattened the Debye-Scherrer circles become straight lines and a transparent net with rectangular co-ordinates is used to measure the angles. The data are then easily plotted in stereographic projection. AUTHOR.

***1364. Two-crystal Weissenberg X-ray goniometer.** W. A. WOOSTER AND A. J. P. MARTIN. *Journ. Sci. Instruments*, **17**, *pp.* 83–89, *April*, 1940. —This paper describes an X-ray goniometer of the Weissenberg type in which two crystals may be alternately exposed to an X-ray beam. The photograph obtained from the reflections on one side of the direct beam contains the spots due to both crystals, one of which is a standard; the photograph obtained from the reflections on the other side of the direct beam contains the spots due to the standard crystal only. In this way difficulties in obtaining relative intensities of reflection due to fluctuations of the X-ray output and to variations in the sensitivity and development of the film are overcome. Unusual features of the instrument include (1) the arrangement of both crystals on the axis of the cylindrical camera, (2) a reversing switch which has no dead centre position even when it is actuated extremely slowly, (3) a 3-phase induction motor to obviate the use of carbon brushes and yet allow of easy reversal. AUTHORS.

1365. Setting of crystals for single-crystal X-ray photographs. H. Arnfelt. *Arkiv f. Kem. Min. och Geologi, Stockholm, B,* **13,** 9, *pp.* 1–7, 1939. *In English.*—A method is described which is based on the same principles as that described by Bernal, but the experimental procedure is different. From rotation photographs the crystal is so adjusted that a zone axis with low indices is in the direction of rotation. Rotation and Weissenberg photographs now give all the necessary information for re-setting the crystal and giving it the final adjustment. J. T.

See also Abstracts 1337, 1352, 1377, 1380, 1426, 1428, 1556, 1602, 1631.

DENSITY.

1366. Density of gaseous chlorine. A. S. Ross and O. Maass. *Canad. J. of Research, B,* **18,** *pp.* 55–65, *Feb.,* 1940.—The density of Cl_2 has been determined over the temperature range 15° to 75°C. and up to 2 atm. The values obtained are compared with those extant in the literature, and excellent agreement is found with the very precise measurements of Jaquerod and Tourpaian at 15°C. and 725 mm. pressure. There is also good agreement, over the temperature range of this investigation, with the measurements of Pier at a pressure of 1 atm. The equation of state proposed by Maass and Mennie is shown to fit the experimental results over the whole range and to give, for temperatures and pressures outside the region covered by this investigation, values of the density of Cl_2 that are in good agreement with the results obtained by Jaquerod and Tourpaian, and by Pier. Tables of calculated and experimentally determined densities and apparent molecular weights show the deviations of Cl_2 from ideality. The equation of state is given in a convenient form for the calculation of the density of the gas in industrial applications. Authors.

See also Abstracts 1432, 1436.

DIFFUSION AND OSMOSIS.

1367. Convective diffusion in parallel flow fields. G. Young. *Math. Biophysics, Bull.,* **2,** *pp.* 49–59, *March,* 1940.—Laminar motion of two viscous incompressible fluids through each other is treated for two cases: flow along the axis of a circular cylinder, and flow between parallel flat plates. Motion of either fluid entails that of the other. Regarding one fluid as a solvent, the other as a solute, and supposing the system to have ends impermeable to the former, it is found that the solvent streams with the solute down the centre of the system, to return in the opposite direction out nearer the walls. Thus diffusion of a dissolved substance through a region in which the solvent is confined produces continual streaming in the latter. Author.

1368. Diffusion of H_2 from water through steel. F. J. Norton. *J. of Applied Physics,* **11,** *pp.* 262–267, *April,* 1940.—Using a metal radio tube having a steel shell as an ionization gauge, the diffusion of H_2 through the steel into the interior was measured. This results from the fundamental corrosion reaction on the exterior, when it is dipped into water: $Fe + H_2O = FeO + H_2$. The protective paint on the tube prevents this, but a bare sandblasted iron surface admits H_2 at 0·13 micron per hour with the shell in water at 25°C. H_2 does not diffuse into the tube when water vapour alone surrounds it. Rates of diffusion were measured through plain and composite metal shells, varying surface treatment and temperature. Author.

1369. Osmotic pressure and dilution entropy of high-molecular solutions. G. V. Schulz. *Zeits. f. phys. Chem. B*, **45**, 2, *pp.* 110–115, 1939.—The objections raised by Boissonnas and K. H. Meyer [see Abstract 611 (1940)] against the author's work on osmotic phenomena [see Abstracts 3921 (1938) and 4319 (1937)]are now shown, after very complete discussion, to be based on erroneous treatment of his data and are therefore invalid. H. H. Ho.

1370. Membrane permeability. Part II. Adsorption of sucrose and two salts on cupric ferrocyanide. B. C. McMahon, E. J. Hartung and W. J. Walbran. *Faraday Soc., Trans.*, **36**, *pp.* 515–522, *April*, 1940.—Careful measurements of the adsorption of hydrated cupric ferrocyanide for sucrose and for NaCl and Na_2SO_4, alone and in presence of sucrose, have been performed. The apparent adsorption of sucrose is negative and results indicate that no sucrose is adsorbed by the gel, the hydration of which remains constant, independent of sucrose concentration. This bound water is regarded as being partly polarized on the gel surface and partly imbibed between the crystallites. Only the former depends on the activity of the water in the solution. NaCl and Na_2SO_4 are also negatively adsorbed, but at low concentration there is evidence of positive adsorption. Slight cationic exchange occurs between the gel and the salts, but no anionic exchange has been detected. In presence of sucrose, the negative adsorption of the salts is diminished, indicating that the imbibed water may be available to the ions though not to sucrose. Hence sucrose cannot be used to measure the hydration of the gel in presence of the salts. A new form of cupric ferrocyanide is recorded. [For Part I see Abstract 1488 (1937).] Authors.

See also Abstracts 1330, 1331, 1332, 1341, 1472, 1555.

ELASTICITY AND PLASTICITY.

1371. Principle of minimum potential in theory of elastic systems. E. Pierrottet. *Accad. Sci. Torino, Atti*, **75**, *Disp.* 1a, *pp.* 47–60, *Nov.–Dec.*, 1939.—The fundamental principles which have been hitherto applied to the problems of elastic systems (the principle of the superposition of effects, the principle of virtual work and the principle of the minimum work) are discussed. It is shown that they all can be replaced by the more general principle of the minimum of potential, expressed in the following form: An elastic system subjected to a complex of sufficiently small forces, and of an arbitrary boundary, assumes a configuration of stable equilibrium for which the potential has a minimum. L. K.

1372. Stress distribution in semi-infinite domain with a plane boundary and compressed by rigid body. H. Ôkubo. *Tohoku Univ., Sci. Reports*, **28**, *pp.* 286–296, *Feb.*, 1940.—This problem is solved mathematically in a two-dimensional case without any assumption of the stress distribution on the contact surface. Some numerical calculations which are useful in technics are also given as examples. Author.

1373. Solution of torsion problems by numerical integration of Poisson's equation. R. Weller, G. H. Shortley and B. Fried. *J. of Applied Physics*, **11**, *pp.* 283–290, *April*, 1940.—This paper considers numerical methods for the solution of Poisson's equation in an arbitrary two-dimensional region with given boundary values. The methods are similar to those discussed by Shortley and Weller for Laplace's equation [see Abstract 2703 (1938)]. It is shown that the entire theory of networks may be applied to Poisson's equation without change. Formulae for the treatment of irregular points and for blocks of points are developed. In addition to the mathematical considerations, the application of the methods to the case of torsion in shafts of any cross-section is described. Additional formulae are derived for the determination of the maximum shear at any point in a shaft as well as the torsional stiffness of such a shaft. AUTHORS.

1374. Terrestrial elastic reactions. P. DESPUJOLS. *Comptes Rendus*, **210,** *p*. 555, *April* 8, 1940.—A correction. [See Abstract 973 (1940).]

1375. Elastic moduli of ferromagnetic materials. Part II. Change in Young's modulus due to magnetization and temperature. R. KIMURA. *Phys. Math. Soc., Japan, Proc.*, **21,** *pp*. 786–799, *Dec.*, 1939.—The ΔE-effect for several polycrystalline materials was investigated at various temperatures. The change in the Young's modulus with temperature variation was also studied. The ΔE-effect was definitely positive; i.e. the Young's modulus increases with the magnetization. The complicated variation of elastic properties with the change of temperature was found to be due to the ΔE-effect. There is no difference between the elastic properties of magnetically saturated ferromagnetic and of other substances. $\Delta S (S = 1/E)$ attains its maximum at a certain temperature, characteristic of each substance, and vanishes at the Curie temperature. For the substance, whose magnetic anisotropy disappears at a certain temperature, the effect is at its maximum in the neighbourhood of this temperature. It was also proved that cementite shows a considerable ΔE-effect. [See Abstract 323 (1940) and following Abstract.] AUTHOR.

1376. Elastic moduli of ferromagnetic materials. Part III. ΔE-effect of iron single crystals. R. KIMURA. *Phys. Math. Soc., Japan, Proc.*, **22,** *pp*. 45–60, *Jan.*, 1940.—With iron single crystals of various orientations the change in the Young's modulus due to magnetization was studied at room temperature. According to the present investigation, the decrease in S'_{33} from the value at the state of no magnetization to the magnetically saturated state is a linear function of $3(\beta_2^2\beta_3^2 + \beta_3^2\beta_1^2 + \beta_1^2\beta_2^2)$. The amount and behaviour of the variation in the modulus showed a conspicuous anisotropy. These striking features concerning the mechanism of the ΔE-effect could be explained by the domain theory of ferromagnetism, by considering the two different processes, discontinuous and continuous rotations of magnetic moments of elementary domains. [See preceding Abstract.] AUTHOR.

1377. Influence of quenching on the elastic moduli of alloys. L. GUILLET, JR., AND A. PORTEVIN. *Comptes Rendus*, **210,** *pp*. 335–338, *Feb*. 26, 1940.—The authors draw attention to the relatively low sensibility of the modulus of elasticity to heat treatment, e.g. for steels and Cu alloyed with 2·5% Be its alteration is less than one-tenth for very large variations in hardness. Further, it is in many cases an almost linear function of composition. The authors point out that for quenched alloys this proportionality applies only with metallic and not with homopolar bonding, as shown in Cu-Al and Cu-Zn alloys of both types. For water-quenched alloys the plot modulus/composition shows minima at 13% in the Cu-Al series and 25% in the Cu-Sn series, but after annealing the plot is linear. For $CuAl_2$ and CuZn with metallic bonds, departures from the mixture rule are respectively 0·6 and 4%, for Cu_9Al_4 and Cu_5Zn_8, 43 and 52%. The order $\rightleftarrows$ disorder transformation in the Au-Cu system is of special interest. For alloys of the compositions shown, water-quenched from

650°C. and reheated for 60 hr. at 380°C. the following results show that the bond is metallic in both states:—

Alloy	Hardness		Resistivity ($m\omega$/cm^3.)		Modulus (kg./mm^2.)		
	Quenched	Annealed	Quenched	Annealed	Quenched	Annealed	Calculated
Cu_3Au	92	108	11·5	8·4	11 500	12 200	11 500
Cu Au	133	180	14	5·8	9 950	10 560	9 500

D. R. H.

1378. Young's moduli of metals and alloys at low temperatures. Part I. Sn, Pb, Sb and their alloys. S. Aoyama and T. Fukuroi. *Tohoku Univ., Sci. Reports*, **28**, *pp.* 423–434, *Feb.*, 1940. *Report No.* 469 *of the Research Inst. for Iron, Steel and Other Metals.*—Young's moduli of Sn, Pb and Sb and their binary alloys are measured at room and low temperatures. The dynamical method of measurement is applied to a fixed-free bar, carrying an iron load on its free end, and the frequency of vibration of that end is estimated by means of a newly devised equipment. Authors.

1379. Variation of principal elastic moduli of Cu_3Au with temperature. S. Siegel. *Phys. Rev.*, **57**, *pp.* 537–545, *March* 15, 1940.—Single crystals of a Cu-Au alloy containing 24·92 atomic % Au were prepared in a vacuum furnace. The crystals were brought to the ordered state at room temperature by an annealing procedure similar to that described by Sykes and Evans. The elastic moduli were measured by the method of the composite piezoelectric oscillator. The elastic moduli are tabulated as a function of temperature over the range 20°C. to 450°C. At the critical temperature, 387·5°C., there is a discontinuity in each modulus-*vs.*-temperature curve. The results indicate that the elastic constants are closely related to the degree of local order. Author.

1380. Elastic moduli and coefficient of expansion through λ-point transition in NH_4Cl. A. W. Lawson. *Phys. Rev.*, **57**, *pp.* 417–426, *March* 1, 1940.—Measurements of the temperature variation of the adiabatic and isothermal Young's and rigidity moduli and of the coefficient of thermal expansion of pressed specimens of NH_4Cl near the λ-point transition at 242·8°K. are reported. It is found that a large difference exists between the adiabatic and isothermal compressibilities below the critical temperature, and hence a large difference between the specific heat at constant pressure and the specific heat at constant volume. The data, in conjunction with the known temperature variation of the specific heat at constant pressure, permit the evaluation of the temperature variation of the specific heat at constant volume, and from this it is concluded that the transition is not to be associated, as previously suggested by Pauling, with the occurrence of almost free rotation of the ammonium radicals in the crystal lattice. Author.

1381. Molecular structure and plasticizing effect. A. Kirkpatrick. *J. of Applied Physics*, **11**, *pp.* 255–261, *April*, 1940.—The inter-relation between the chemical constitution and structure of plasticizers and plastics is discussed. The results obtained with sulphonamide, phthalate and phosphate plasticizers in cellulose acetate compositions are used as examples and the author speculates on the possibility of formulating general rules from such data. Author.

1382. Tension and birefringence in a vinylite plastic. H. W. Farwell. *J. of Applied Physics*, **11**, *pp*. 274–279, *April*, 1940.—This paper describes experiments on the birefringence of a strip of plastic material, first when the stretched strip is maintained at constant length and second when it carries a constant load. The results indicate that in neither case is the birefringence proportional to the tension. The data are further examined, and the argument is presented to show that in the constant length experiment the ratio of tension T at any time after the initial tension, T_1, is established should be the same function of the time as is the expression $[1 - 2\mu \log_e(L/L_1)]$ for the constant load experiment. Finally it is shown that the tension ratio data can be represented by a curve of the type, $T'/T_1 = Ae^{-at} + Be^{-bt} + Ce^{-ct}$. Author.

1383. Vibrations of an elastic sphere with central core. J. G. Scholte. *K. Ned. Akad. Wet., Proc.*, **42**, 10, *pp*. 918–929, 1939. *In English*.—Gravity is taken into account in obtaining period equations for the oscillation of a sphere with central core. W. A. R.

1384. Second-order effects in elastic vibrations. P. Teofilato. *Pont. Acad. Sci., Acta*, **3**, 13–14, *pp*. 85–112, 1939.—In the first part a theoretical treatment of an extension of Hooke's law is given in which second-order effects are included. In the second part this theory is applied to the problem of the vibrations of a cylindrical tube of infinite length on whose walls a periodic pressure is exerted. It is shown that new frequencies and new possibilities of resonance occur if second order effects are taken into account. Resonance occurs now if a proper vibration of the wall coincides with the sum or difference of two proper vibrations or of two frequencies of the fluctuating pressure or of one proper vibration and of one pressure frequency. Steel is shown to have proper vibrations at $3/2\pi a$ and $20/2\pi a$ kc./s. if a is the radius of the tube in cm. and the thickness of the wall is very small. L. K.

1385. Relaxation oscillations. G. F. Herrenden-Harker. *Am. J. Phys.*, **8**, *pp*. 1–22, *Feb*., 1940.—A general study of the subject in relation to certain mechanical, electrical and biological problems. The treatment is one of methods rather than of the solutions of specific problems. S. A. S.

1386. Analysis of symmetrical vibrating systems. L. A. Pipes. *J. of Applied Physics*, **11**, *pp*. 279–282, *April*, 1940.—The Lagrangian equations of motion of a general mechanical system of n degrees of freedom that is executing small motions about a position of equilibrium are subjected to a Laplacian transformation. The transformed equations are then subjected to a similarity transformation. By means of this transformation, a separation of the transformed equations is effected provided the system has the special type of symmetry under consideration. The solution of the usual determinantal equation is avoided. The methods of the Laplacian transformation and matrix algebra as presented in previous papers are assumed in the discussion. Author.

***1387. Tensile tele-measurements concerned with the security of engineering structures.** F. Tölke. *Naturwiss.*, **28**, *pp*. 17–24, *Jan*. 12, 1940.—Structures are now usually erected more rapidly than previously; this has necessitated the provision of instruments for following, at a distance, the settling of the structure into its final condition of equilibrium. Appliances and installations comprising (1) a resistance thermometer, (2) an electro-acoustic device incorporating a vibrating fibre, (3) the electrical resistance telemeter due to McCollum and Peters [see Abstract 1084B (1924)], (4) the electromagnetic dilatometer due to Fuess, and (5) the pneumatic pressure device due to Detig are described, and illustrated and their applications briefly discussed. J. S. G. T.

See also Abstract 1622 and
702B. Elastic moduli of alloys. L. Guillet.

GRAVITATION.

1388. Gravity anomaly an important factor in earth science. W. Bowie. *Science*, **91**, *pp*. 158–160, *Feb*. 16, 1940.—The International Geodetic Association has adopted the following gravity formula $\gamma_0 = 978{\cdot}049 (1 + 0{\cdot}005\,2884 \sin^2 \phi - 0{\cdot}000\,005\,9 \sin^2 2\phi)$ gals, in which γ_0 is the value of gravity at sea level and ϕ is the latitude of the station. The constants are derived from observed values of gravity in many countries and at different latitudes. The corrections which have to be applied to the observed value of gravity to obtain the gravity anomaly, and the variations of the anomaly over the earth are discussed. The means by which improved values for the constants may be obtained are considered and Heiskanen is to derive a new formula along these lines. R. S. R.

1389. Comparison of "g" at the National Laboratory, Teddington, and the Bureau of Standards, Washington, D.C. B. C. Browne and E. C. Bullard. *Roy. Soc., Proc. A*, **175**, *pp*. 110–117, *March* 28, 1940.—The values of "g" at the points used for the recent absolute determinations at the N.P.L., Teddington, and at the N.B. of S., Washington, D.C., have been compared. The difference found is $1{\cdot}096_9$ cm./sec^2. The difference between the two absolute determinations is $1{\cdot}101_5$ cm./sec.^{2} whilst that deduced from previous indirect relative connections is $1{\cdot}095_3$ cm./sec^2. The agreement is within the uncertainties of the measurements, and leaves little doubt that the hitherto accepted value at Potsdam is some seventeen parts in a million too great. Authors.

See also Abstract 1383.

HYDRODYNAMICS AND AERODYNAMICS.

1390. Probability equations of a turbulent fluid. G. Dedebant, J. Moyal and P. Wehrlé. *Comptes Rendus*, **210**, *pp*. 243–245, *Feb*. 12, *and pp*. 332–334, *Feb*. 26, 1940.—These papers are part of a series on the theory of probability and its applications. In the earlier paper the authors deal with the function of distribution of a chance function derivable in quadratic mean and applications to :—(1) Stationary chance functions, and (2) the kinetic theory of gases. In the later paper the following matters are dealt with : (*a*) Hydrodynamical analogy, (*b*) an equation of generalized transfer and the obtaining for the fluid of probability equations of motion and of energy analogous to those of classical hydrodynamics, (*c*) application to the establishment of the equations for probable values of a turbulent fluid. J. J. S.

1391. Explicit resolution of equation for wing or blade. Legras. *Comptes Rendus*, **210**, *pp*. 367–369, *March* 4, 1940.—The numerical solution for the case of a wing or blade of elliptic form is now derived by means of a series of fundamental functions with the reservation of certain conditions of convergence. The paper is entirely mathematical. H. H. Ho.

1392. General variation-principle in hydrodynamics. H. Ertel. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No*. 7, [9 *pp*.], 1939.—The Eulerian equations of motion in hydrodynamics are only derivable from a variation-principle when the density is a function of the pressure only. In this paper it is shown that the Langrangian form of the equations can be derived from $\delta\iiiint L\,da\,db\,dc\,dt$, ($a$, b, c, initial co-ordinates) with $L = \delta_0\{v^2/2 + (\omega\,.\,[\mathbf{r} \times \mathbf{v}]) - \Phi\} + \theta p$, referred to axes rotating with angular velocity ω, where $\mathbf{v}$ is the particle velocity, $\mathbf{r}$ its (vector) position with components x, y, z, Φ the potential of the external forces including that of the centrifugal force, $\theta = \partial(x, y, z)/\partial(a.\ b, c)$, p the pressure, and ρ_0 the initial density. W. G. B.

1393. Determination of the projection of minimum resistance of a wave. C. FERRARI. *Accad. Sci. Torino, Atti*, **75,** *Disp.* 1*a*, *pp.* 61–96, *Nov.–Dec.*, 1939.—Continuation of a previous paper [see Abstract 979 (1940)] treating of the determination of the arch of minimum resistance of a wave, taking the limited hypothesis that the perturbations produced by the obstacle are so small that the equation of motion may be assumed to be linear. The object of the research is to determine the force that is exerted on the solid not directly by the amounts of the pressure on the contour of the body so much as of the loss of energy that is produced by the waves of general shock of the obstacle. Thus it is possible to express the force mentioned by means of the values that the various physical magnitudes assume in correspondence with the wave front, and that depend on its form, avoiding inquiry into the general integral of the equation of motion which is not known. Then the form of the wave is studied which makes the force a minimum, taking into account the considerations deduced by analogy from the corresponding problem of plane motion and making use of Tricomi's results. Then the method of integration " step by step " is applied to the determination of the field of motion and of the form of the body which generates the wave first found. A numerical application of the method is given. J. J. S.

1394. Flow of a compressible fluid past a sphere. K. TAMADA. *Phys. Math. Soc. Japan, Proc.*, **21,** *pp.* 743–752, *Dec.*, 1939.—The steady irrotational flow of a compressible fluid past a sphere is investigated. Starting with the well-known solution for the incompressible fluid flow as the zero approximation, the second-order correction to the velocity potential is obtained by applying Poggi's method. Performing some numerical calculations, the velocity distributions on the surface of the sphere when the Mach number for the undisturbed flow is 0·4 and 0·5 respectively are shown graphically in comparison with the velocity distributions corresponding with the case of the incompressible fluid flow as well as with the first approximate solution for the compressible fluid flow. AUTHOR.

1395. Forces on two parallel co-axial discs placed in uniform flow. Y. NOMURA. *Tohoku Univ., Sci. Reports*, **28,** *pp.* 305–318, *Feb.*, 1940.—The velocity potential of the irrotational liquid flow past two fixed coaxial discs is found in terms of cylindrical co-ordinates with the help of the hypergeometrical polynomials. The resultant force acting on each of the two discs is calculated. As a numerical example, the case of two equal discs is taken.

1396. Flow at entrance to open channel. L. ESCANDE. *Comptes Rendus*, **210,** *pp.* 133–136, *Jan.* 22, *and pp.* 211–213, *Feb.* 5, 1940.—Expressions concerned with the *vena contracta* and the free flow of liquid at the entrance to an open horizontal conduit of rectangular cross-section connected with a large reservoir are briefly discussed. The theoretical deductions are confirmed experimentally. J. S. G. T.

1397. Invariant theory of isotropic turbulence. H. P. ROBERTSON. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 209–223, *April*, 1940.—Relevant theorems of the theory of invariants are briefly discussed and applied to a direct, simplified and systematized determination of the form of the correlation tensors occurring in the kinematical part of the theory of isotropic turbulence. J. S. G. T.

1398. Waves produced by rolling of ship. T. H. Havelock. *Phil. Mag.*, **29**, *pp*. 407–414, *April*, 1940.—Expressions are obtained for the surface disturbance produced by a cylinder, of elliptic cross-section, submerged in water and making small oscillations. A simple form of these results is used as a first approximation for the height of the waves, supposed two-dimensional, sent out on either side by a rolling ship. Numerical calculations are made for cases for which a similar estimate has been made by an energy method due to W. Froude; the results by the two methods are of the same order of magnitude. Author.

***1399. Recording water-flow meter.** E. C. Childs. *Journ. Sci. Instruments*, **17**, *pp*. 93–94, *April*, 1940.—A description is given of a recording meter of simple design, particularly suited for recording the instantaneous rate of flow of water from the outfall pipes of agricultural drainage systems. Two ranges have so far been constructed, with reasonable linearity of scale, dealing with rates of flow up to about 40 l./min. A record of the water flow from a mole drain in heavy land is shown, illustrating the need for such a recorder in many drainage experiments. Author.

See also Abstracts **1431, 1470, 1614, 1620, 1634**, and **750B.** Calibration of differential manometers and ring balances for measurement of flow. F. Schiffner.

KINETIC THEORY OF MATTER.

1400. Boltzmann equation. A. Lichnerowicz and R. Marrot. *Comptes Rendus*, **210**, *pp*. 391–393, *March* 11, 1940.—Mathematical.

1401. Brownian motion in field of force and diffusion model of chemical reactions. H. A. Kramers. *Physica*, **7**, *pp*. 284–304, *April*, 1940. *In English*.—A particle which is caught in a potential hole and, through the shuttling action of Brownian motion, can escape over a potential barrier yields a suitable model for elucidating the applicability of the transition-state method for calculating the rate of chemical reactions. Author.

See also Abstract 1390.

LENGTH, AREA AND VOLUME.

1402. Determination of external diameter of screw threads with symmetrical profile by 3-wire method. G. Berndt. *Zeits. f. Instrumentenk.*, **59**, *pp*. 439–448, *Nov.*, 1939.—This forms an extension of the method developed in an earlier paper [see Abstract 1468 (1932)]. The algebraic and geometrical considerations of the method and the influence of various sources of error are considered. R. S. R.

***1403. Levers of constant ratio.** R. S. Clay. *Journ. Sci. Instruments*, **17**, *pp*. 49–55, *March*, 1940.—Describes the desiderata for simple and bent levers and a lever with connecting link and illustrates the applications of levers of constant ratio. The latter are, the graduation of a linear scale, graduation of a circular scale, chasing screw-threads on a lathe, for dividing uneven scales, and for dividing to conform to a calibration formula. S. A. S.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1404. Approximate polynomial solutions to integral equations. P. D. Crout. *J. Math. Phys.*, **19**, *pp*. 34–92, *Jan.*, 1940.—It is shown how algebraic polynomials can be used to obtain approximate solutions of integral equations. In Part I, the approximate representation of a given curve by a polynomial is discussed; in Part II, the integral equations arising in three physical problems are formulated and solved by the approximate methods and the solutions are shown to conform closely to the exact solutions; in Part III, the accuracy, application and extension of the method are discussed. W. S. S.

1405. Determination of optimum curve through experimental points. P. VERNOTTE. *Comptes Rendus*, **210**, *pp*. 329–331, *Feb*. 26, 1940.—It is an extremely difficult thing to trace an experimental curve, and moreover there is much uncertainty in a theoretical interpretation founded on the peculiarities of such a curve. All the methods proposed for getting over this difficulty (least squares, equal coefficients, etc.) have the common defect of attributing the same mean value to the experimental ordinates and the calculated ordinates. This procedure, however, will give only one relation for determining the parameters of the theoretical curve. The author's suggestion is to divide the experimental domain into p regions called fundamental and to write that in each of these regions the experimental function, defined roughly by the experimental points, has the same mean value as the theoretical function. There is calculated not a simple mean of the ordinates but a true mean value—by graphical quadrature for the experimental function, by integration for the theoretical function. Thus the measurements are no longer considered as isolated and there is applied to them the relation of continuity. Experience has shown that the theoretical curves thus obtained follow more intimately the experimental points. The author further develops his method in detail in the paper. J. J. S.

***1406. Method of solving second-order simultaneous linear differential equations using the Mallock machine.** M. V. WILKES. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 204–208, *April*, 1940.—The paper describes a method of integrating differential equations by means of the Mallock linear equation machine. The method, which is based on one described by Hartree, is applicable to pairs of second-order simultaneous linear ordinary differential equations in two unknowns. Any required degree of accuracy in the solution can be obtained. AUTHOR.

1407. Measurement in physics. R. B. LINDSAY. *Am. J. Phys.*, **8**, *pp*. 22–27, *Feb*., 1940.—A re-examination of certain aspects of the meaning of measurements in physics, particularly in the microscopic domain. S. A. S.

1408. Normal m.k.s. system of units. F. W. WARBURTON. *Am. J. Phys.*, **8**, *pp*. 30–38, *Feb*., 1940.—A discussion of certain questions arising in a study of systems of electric and magnetic units, leading to a presentation of new normal and basic systems which represent, to a considerable extent, the present status and usage of electric quantities. S. A. S.

See also Abstracts 1373, 1385, 1386, 1390, 1391, 1442, 1547.

MECHANICS, QUANTUM.

1409. Equations of Dirac-Madelung. J. YVON. *J. de Physique et le Radium*, **1**, *pp*. 18–24, *Jan*., 1940.—Continuing the work of Madelung by which the Schrödinger mechanics of the electron are shown to be equivalent to the treatment of the electron as a continuous electric fluid, the author indicates how the relativistic mechanics of Dirac can undergo the same transformations. The tensorial formulae obtained still present a certain aspect of classical electrodynamics. They give values to the geometrical characters of scalars, vectors and tensors connected with the electron. The results will possibly be of value in obtaining the improvements which the quantum theory of radiation appears to require. G. O. B.

1410. Eigenvalues and eigenfunctions. E. Schrödinger. *Roy. Irish Acad., Proc.*, **46A,** 2, *pp.* 9–16, 1940.—A method, called that of adjoint first-order operators, of determining quantum-mechanical eigenvalues and eigenfunctions, is described. The eigenfunctions of the line spectra result from a quite simple elementary quadrature. It is shown how the operators turn an eigenfunction belonging to the eigenvalue λ—unless they annihilate it—into an eigenfunction belonging to $\lambda + 2$ or $\lambda - 2$ respectively. Various applications of the method are indicated ; of particular interest is that to Kepler motion in the hypersphere and that showing clearly the way in which the line spectrum depends on the structure of the equation. G. O. B.

1411. Angular momentum of particles with zero rest mass and any spin. M. Fierz. *Helv. Phys. Acta*, **13,** 1, *pp.* 45–60, 1940. *In German.*—The theory of wave fields of particles with spin $f \gg 1$ and zero rest mass, must be considered as a degenerate limiting case of the theory for particles with finite rest mass. The degeneracy is apparent in the appearance of a standard group. In this paper it is shown that the degeneracy has the further consequence that such a wave field, in the case when only a single field quantum is present, always possesses an angular momentum $j \gg f$. This principle will further prove that the differential equations of the field can be solved by spherical waves which admit standard invariant field magnitudes and which transform by spatial rotation about the source, according to an irreducible representation θ_j of the rotation group. By this it is shown that j must be greater than or equal to f. For the given $j \gg f$ there are always, however, 2 groups of $2j + 1$ linearly independent spherical waves. G. O. B.

1412. Analogy of Schrödinger differential equation with a wave equation. F. Matossi. *Phys. Zeits.*, **41,** *pp.* 47–52, *Jan.* 15, 1940.—Acting on a suggestion of Schrödinger, the author adds an additional term to the Schrödinger differential equation. This term is supposed to extend the analogy to include the broadening of a wave in an inhomogeneous medium. The detailed examination of two problems, that of the linear oscillator and that of Kepler motion, shows that the extended Schrödinger equation gives results inconsistent with the observed facts. G. O. B.

1413. Partition functions and energy levels of molecules with internal torsional motions. B. L. Crawford, Jr. *J. Chem. Phys.*, **8,** *pp.* 273–281, *March*, 1940.—The complete energy matrix is set up for external and (hindered) internal rotations of " pseudo-rigid " molecules, i.e. molecules consisting of a rigid framework to which symmetric hindered rotators are attached. The reduced secular equation for the energy levels of such a molecule with one internal rotation is given explicitly. By using the perturbation method of Wilson, the partition function for this model is found, correct to the second order. Effects due to angular momentum couplings are included. A simple method for the calculation of thermodynamic contributions of hindered internal rotations is given. As an example, the application of the method to propylene is described ; in this case, the coupling terms here included may amount to as much as 19% of the effect of the hindering potential on the thermodynamic contributions. Author.

1414. Electromagnetic self-energy of mesotrons. R. D. Richtmyer. *Phys. Rev.*, **57,** *pp.* 413–416, *March* 1, 1940.—The author has calculated the electromagnetic self-energy of a mesotron of unit spin according to the Proca-Yukawa-Kemmer theory by an approximate method equivalent to the second order of perturbation theory. The method enables the result to be separated into various parts whose physical significance can be seen more clearly than that of the total result, but is of course open to the same objection as perturbation theory for such calculations. The various parts of the self-energy are due to the longitudinal electric field (Coulomb part), the transverse electric field (arising from the spin), the magnetic field (also from spin) and a part due to the influence of the zero point fluctuations of the radiation field on the motion and therefore on the proper field of the particle. In terms of a "cut-off" radius a, introduced to make the various contributions finite, but which will later be set equal to zero, the first and last parts diverge as $1/a^2$. The second and third parts diverge as $1/a^4$, but are of opposite sign and cancel to this order. The whole self-energy diverges as $1/a^2$ in the author's approximation. These results are compared with similar ones for spins 0 and $\frac{1}{2}$ recently obtained by Weisskopf [see Abstract 3149 (1939)]. AUTHOR.

1415. Quantization of mass. B. PODOLSKY AND H. BRANSON. *Phys. Rev.*, **57**, *pp.* 494–500, *March* 15, 1940.—The Dirac equation may be written so as to give an eigenvalue problem whose eigenvalues would be values of the electron mass. The equation is solved in several cosmological spaces, none requiring any quantization of m. A space-time suggested by Eddington leads to wave equations that have solutions with quantized m, m depending upon the radius of the universe, constants c and h, and a quantum number. If the radius of the universe is taken as 10^{28} cm., the lowest mass state in this group of solutions is of the order of 10^{-65} gm. Conversely if the usual electron mass is considered as the lowest state, the radius of the universe is of the order of 10^{-10} cm. Since the only constants occurring in the theory are h, m, and c, one would expect that the radius of the universe would come out in terms of h/mc. Only an occurrence, as the result of quantization, of a large dimensionless number could lead to a reasonable result; but Dirac's equation evidently does not provide such a number, and is therefore unsuited to account for the electron mass in terms of the radius of the universe. AUTHORS.

1416. Degeneracy in quantum mechanics. J. M. JAUCH AND E. L. HILL. *Phys. Rev.*, **57**, *pp.* 641–645, *April* 1, 1940.—The problem of degeneracy in quantum mechanics is related to the existence of groups of contact transformations under which the Hamiltonian is invariant. The correspondence between transformations in classical and quantum theories is developed. The Fock-Bargmann treatment of the symmetry group of the hydrogenic atom comes under this theory. The symmetry group of the 2-dimensional Kepler problem is found to be the 3-dimensional rotation group; that of the n-dimensional isotropic oscillator is isomorphic to the unimodular unitary group in n dimensions. The 2-dimensional anisotropic oscillator has the same symmetry as the isotropic oscillator in classical mechanics, but the quantum-mechanical problem presents complications which leave its symmetry group in doubt. AUTHORS.

1417. Statistics of elementary particles. W. PAULI AND F. J. BELINFANTE. *Physica*, **7**, *pp.* 177–192, *March*, 1940. *In English.*—In building up a quantized field theory of free elementary particles, use is made of three postulates; (I) that of positive energy, (II) that of commutativity of observables in points connected by a space-like vector, and (III) that of unspecified charge invariance of all physically significant quantities. In the case of zero spin it is shown that postulates (I) and (III) do not exclude Fermi-Dirac statistics in the general case that more than one scalar and its conjugate complex are regarded as field components. The postulate (II) always suffices for this purpose in the case of integer spin; (I) and (III) are here superfluous since they are fulfilled automatically if (II) is satisfied. There also exist cases with integer spin and Fermi-Dirac statistics where (I) and (III) are fulfilled but not (II). G. O. B.

1418. Connection between spin and statistics of elementary particles. J. S. DE WET. *Phys. Rev.*, **57**, *pp*. 646–652, *April* 1, 1940.—It is shown that Fermi-Dirac quantization by the procedure of Heisenberg and Pauli cannot be carried out for tensor wave equations. Since the general wave equations, for particles with integral spin are tensor equations, it follows that for these integral spin equations Fermi-Dirac quantization cannot be carried out. During the course of the discussion it appears that for equations derived from Lagrangians which are nonlinear in the derivatives of the functions, Fermi-Dirac quantization cannot be carried out. Since the Heisenberg-Pauli theory applies only to non-linear Lagrangians, a special discussion of linear Lagrangians (linear in the derivatives of the functions) is given. It is shown how equations derived from such Lagrangians can be put into Hamiltonian form. Lagrangians of this type occur for the equations for half-odd spin. AUTHOR.

See also Abstracts 1646, 1652.

PRESSURE.

See Abstract 1422.

RELATIVITY AND ETHER.

See Abstract 1614.

SOLUTION.

1419. Calculation of solute activities from activities of the solvent. M. RANDALL AND B. LONGTIN. *J. Phys. Chem.*, **44**, *pp*. 306–313, *March*, 1940.—A new function $h' = (N_1/N_2) \ln (a_1/N_1)$ is defined which allows the direct calculation of the activity coefficient (a_2/N_2) of the solute from that of the solvent to be made in the same manner that the coefficient (a_2/m) may be calculated from the function h defined by Lewis and Randall. Experimental errors in determining a_1 produce infinite errors in the functions $h/(N_2/N_1)$ and $h'/(N_2/N_1)$ at infinite dilutions. If the curves of $h/(N_2/N_1)$ and $h'/(N_2/N_1)$ *vs*. (N_2/N_1) can be extrapolated to infinite dilution with no more than a finite error, the values of the solute activity coefficients (a_2/N_2) and (a_2/m) obtained from the extrapolated curves will be infinitely more accurate at infinite dilution (i.e. the error is reduced by a factor of ∞) than could be obtained from the experimental data alone. The extrapolation can be made to within a finite error provided the functions $h/(N_2/N_1)$ and $h'(N_2/N_1)$ have finite limits. For an ideal solution $h'/(N_2/N_1)$ should be everywhere zero, while $h/(N_2/N_1)$ has a definite form as a function of (N_2/N_1) with the limiting value of 1/2 and the limiting slope $-1/3$. Different types of deviations from ideality and their effects on the limiting values and limiting slopes of the $h/(N_2/N_1)$ and $h'/(N_2/N_1)$ *vs*. (N_2/N_1) curves are discussed. [See following Abstract.] AUTHORS.

1420. Approximate rules for solute activities in dilute solutions of non-electrolytes. Generalized form of Bury's rule. M. RANDALL, W. F. LIBBY AND B. LONGTIN. *J. Phys. Chem.*, **44**, *pp*. 313–321, *March*, 1940.—A simple general method of residues is given for obtaining the coefficients in a Maclaurin's series directly from experimental data. The functions (h/m) and (j/m) used in calculating solute activities are shown to form special cases of the application of this method. Equations are given whereby the solute activity may be calculated accurately for solutions up to about 5 M from a knowledge of the limiting values of the function (h/m) and the slope of a curve of (h/m) *vs.* m (likewise (j/m) and the slope of a curve of (j/m) *vs.* m) at infinite dilution. It is shown that Bury's rule and analogous rules may be useful in obtaining improved values of freezing point lowerings and solvent activities from extrapolated curves of j/m and h/m *vs.* m, respectively. This follows since in some cases it is possible to extrapolate (j/m) and (h/m) with an accuracy greater than that of the experimental data. [See preceding Abstract.] AUTHORS.

1421. Solubility of SO_2 in water. W. L. BEUSCHLEIN AND L. O. SIMENSON. *Am. Chem. Soc., J.*, **62**, *pp.* 610–612, *March*, 1940.—Partial vapour pressures for SO_2 in the system SO_2 in water have been determined over the temperature range 20–110° and total pressure range of 10 to 150 cm. of Hg for concentrations of 0·51, 1·09, 4·36 and 7·45 gm. of SO_2 in 100 gm. of water. These data extend the values of the International Critical Tables and show excellent agreement over the coincident ranges. AUTHORS.

See also Abstract 1361.

SURFACE PROPERTIES.

1422. Equilibrium pressures of oxygen adsorbed on activated charcoal. M. J. MARSHALL AND R. A. FINDLAY. *Canad. J. of Research, B*, **18**, *pp.* 36–43, *Feb.*, 1940.—O_2 chemisorbed on activated cocoanut charcoal at 20°C. was found to exert no measurable equilibrium pressure. The small residual pressures obtained under experimental conditions were shown to be due to the presence of slight impurities in the O_2 employed. The impurities responsible for these residual pressures were largely N_2 and accompanying rare gases. The velocity of chemisorption of O_2 decreased rapidly with increase in its concentration on the charcoal, approaching a limiting zero velocity at a concentration of 84×10^{-6} mol./gm. This coincides with the concentration at which the heat of adsorption drops rapidly to the limiting value obtained for physical adsorption. After this limiting concentration was reached, adsorbed O_2 showed true equilibrium with the gas phase. For small additional increases in concentration, the equilibrium pressure was found to increase as a linear function of the concentration, with a proportionality constant of 0·276 mm. per micromole. This represents physical adsorption as compared to chemisorption for lower O_2 concentrations. AUTHORS.

1423. Chemisorption of olefines on nickel. G. H. TWIGG AND E. K. RIDEAL. *Faraday Soc., Trans.*, **36**, *pp.* 533–537, *April*, 1940.—Information derived from exchange reactions showed that olefines are chemisorbed to a Ni surface with opening of the double bond and adsorption to two Ni atoms. Calculations have been made which show that this mode of adsorption is possible with very little distortion of the adsorbed molecule. The effect of the interatomic spacing of the catalyst atoms is discussed and the view is advanced that this will be an important factor in the hydrogenation of double bonds where two point contact is required. Calculations were also made qualitatively of the interaction between neighbouring adsorbed olefine molecules. It has been shown that for ethylene there is little or no interaction, especially when adsorption is on the 110 crystal plane; ethylene can therefore cover the whole catalyst surface. For the higher olefines, however, interaction is considerable and these molecules cannot cover the whole surface. The experimental evidence confirms these conclusions. AUTHORS.

1424. Adsorption of dipoles. A. R. MILLER. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 242–243, *April*, 1940.—A correction. [See Abstract 352 (1940).]

1425. Surface tension of liquid D_2. A. VAN ITTERBEEK. *Physica*, **7**, *pp.* 325–328, *April*, 1940. *In English.*—The surface tension ψ_σ of liquid D_2 has been determined by means of the capillary rise method. It is found that between 20·4°K. and 18·7°K., $(\psi_\sigma)_{D^2}/(\psi_\sigma)_{H^2}$ varies between 1·74 and 1·67. (The ratio of the densities is nearly constant and equal to about 2·40.) It is found for D_2 that the capillary rise H as a function of the temperature is a straight line, H vanishes at $T = 46$°K. Consequently this temperature can be considered as an approximate value for the critical temperature of D_2. AUTHOR.

1426. Cr films on rock-salt. S. SHIRAI. *Phys. Math. Soc. Japan, Proc.*, **21**, *pp.* 800–807, *Dec.*, 1939.—An account is given of electron diffraction experiments to determine the structure of Cr films, deposited on the cleavage faces of rock-salt after various treatments. Apparatus described in a previous paper is used [see Abstract 135 (1939)]. If the Cr solidifies at low temperatures (about 300°C.), the small Cr crystals are not uniformly oriented. The longer the rock-salt is maintained at a high temperature (about 500°C.) before the deposition, the more perfect the cleavage planes become. Results are also given for deposition preceded by treatment of the rock-salt with H_2; results for Cr are compared with those previously obtained for Fe. E. E. W.

1427. Oxide films on Mg, Al and Be. S. YAMAGUCHI. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 942, *pp.* 463–470, *Dec.*, 1939.—Electron-diffraction experiments have been carried out to investigate the non-corrosion in air of metals other than Fe. The present paper gives results for Mg, Al and Be, obtained with an apparatus previously described. It is suggested that the absence of corrosion is due to the formation of an oxide layer which, although exceedingly thin, is impervious to atmospheric O_2. In the case of Mg, photographs taken after exposure to the air at various temperatures indicate that at ordinary temperatures the layer is only 10 Å thick. With Al, the γ-oxide is found to be present between room-temperature and 400°C.; above this there is a transition to the α-oxide. Photographs of pure Be and of an Al-Be alloy (30% Be) give no conclusive information for room temperature, but a layer of BeO is observed at temperatures above 400°C. E. E. W.

1428. Surface reaction between nickel oxide and corundum. H. R. THIRSK AND E. J. WHITMORE. *Faraday Soc., Trans.*, **36**, *pp.* 565–574, *April*, 1940.—The structure, orientation and spinel-formation of crystalline NiO films condensed on to heated corundum single crystals have been studied by electron diffraction. It was found that the NiO crystals take up, with respect to the substrate crystal, certain special orientations according to the crystallographic direction of the corundum surface. These orientations have been explained in terms of geometrical similarities between the two crystals in important planes near the junction surface. The NiO was shown to react slowly at about 900°C. with the corundum to form nickel spinel, which takes up orientations similar to those of the NiO.

Certain of these results can be explained on the assumption that the spinel lattice is the only one of the three in which appreciable diffusion of metal ions can occur. AUTHORS.

1429. Evidence of surface films from secondary variations of reflecting power. J. LOISELEUR. *Comptes Rendus*, **210**, *pp.* 369–371, *March* 4, 1940. —Irregular variations of reflecting power have enabled detection of the existence of molecular surface films. These films, in the case of Ag surfaces and especially when formed by the action of chromic acid upon them, appreciably retard sulphuration by H_2S or $(NH_4)_2S$. H. H. Ho.

1430. Monolayers of compounds with branched hydrocarbon chains. Part I. Di-substituted acetic acids. E. STENHAGEN. *Faraday Soc., Trans.*, **36**, *pp.* 597–606, *April*, 1940.—Force-area and surface potential—area relations are given for a number of branched chain carboxylic acids of the di-substituted acetic acid type, with a total number of C atoms from 14 to 38. For unionized aliphatic acids the following applies : (*a*) The monolayers are of the liquid expanded type, with the exception of the C_{14} acids, which are vapour expanded. (*b*) For a given number of C atoms the monolayers become more expanded with the displacement of the carboxyl group from the end to the middle of the chain, i.e. with increasing symmetry of the di-substituted acetic acid. (*c*) Increase in the total number of C atoms has a condensing effect at low surface pressures, and also at higher pressures if the short chain contains less than 4 C atoms ; if longer, expansion occurs at higher pressures. (*d*) The apparent surface moment μ tends to increase with increasing expansion. Acids containing alicylic rings are, due to the size of the rings, very expanded, and show comparatively high surface moments. On neutral substrates the monolayers undergo a relative expansion at low pressures, and a contraction at higher pressures. Ions of divalent metals have a slight condensing effect on the whole force-area curve. In the fully ionized state, on substrates having a *p*H of 11 or higher, the acids give vapour films. AUTHOR.

See also Abstracts 1352, 1370, 1595, 1602, 1662, and
689B. Lubrication. Part VI. F. Morgan, M. Muskat and D. W. Reed.

VISCOSITY AND FRICTION.

1431. Structural viscosity in liquids and derivation of equations for flux through tubes. F. BREAZEALE. *J. of Applied Physics*, **11**, *pp.* 187–192, *March*, 1940.—It is shown how the flux (through a tube) of certain fluids which show no yield value but do show structural viscosity, may be calculated with fair accuracy in the Bingham region. If it be assumed that the viscosity $\sim$ rate of shear relation is irreversible above S_0 (corresponding to β on the curve) the expression derived for flux in this region agrees in character with the experimental curve obtained with the " solution " under discussion. The actual discrepancies between the two curves will, according to the author's theory, decrease as the transition from reversibility to irreversibility becomes more rapid (magnitude of the " progressive thixotropy "). In the present case, the theory describes the transition as comparatively gradual. AUTHOR.

1432. Viscosity of electrolytic mixtures in dilute solution. A. S. CHACRAVARTI AND B. PRASAD. *Faraday Soc., Trans.*, **36**, *pp.* 557–560, *April*, 1940.—Viscosity and density of mixed solutions of $BaCl_2$ with NaCl and $MgCl_2$ with NaCl in 3 different proportions as well as the values for pure NaCl are reported. Onsager and Fuoss's limiting law for mixed

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19

ionic solutions has been established in these cases. An equation of the Jones and Dole type has been applied with success to all the mixed solutions. The coefficient of the square root term " A " has been shown to be a linear function of composition. [See Abstract 71 (1940).] AUTHORS.

1433. Effect of HCl on viscosity of $BaCl_2$ and $MgCl_2$ solutions. A. S. CHACRAVARTI AND B. PRASAD. *Faraday Soc., Trans.*, **36**, *pp.* 561–564, *April*, 1940.—The Jones and Dole type of equation is obeyed by $BaCl_2$ and $MgCl_2$, if a dilute solution of HCl is used as solvent instead of pure water. Of course, "1"—the relative viscosity of water—has to be replaced by η_{HCl}/η_0, the relative viscosity of the HCl solution which is used as solvent, the equation assuming the form: $\eta/\eta_0 = \eta_{HCl}/\eta_0 + A\sqrt{c} + Bc$. The value of " A " decreases linearly with increase in the concentration of the HCl solution used as solvent up to a certain concentration where it becomes zero. Beyond this point, the value remains stationary at zero. The value of " A " extrapolated to zero concentration of acids is in fair agreement with the experimental as well as the theoretical value. AUTHORS.

1434. Temperature variation of viscosity in non-polar and dipolar inorganic liquids. S. T. BOWDEN AND A. R. MORGAN. *Phil. Mag.*, **29**, *pp.* 367–378, *April*, 1940.—The viscosity of some representative non-polar and dipolar inorganic liquids has been measured at a series of temperatures with a view to testing the applicability of the exponential formula. It is found that the majority of the liquids conform fairly closely to the Andrade relation, the largest departures being shown by PCl_3 and $SnCl_4$. The connection between the values of the constants of the exponential formula and the other physical properties of the liquids is discussed. In so far as viscosity phenomena are concerned, it is shown that the majority of these substances are normal liquids, which do not suffer change of association with temperature and thus conform to the Andrade relation in the manner of organic liquids. AUTHORS.

1435. Viscosity of gases at low pressures. A. VAN ITTERBEEK AND O. VAN PAEMEL. *Physica*, **7**, *pp.* 273–283, *April*, 1940. *In English.*—Measurements are made, using the oscillating disc method, on the viscosity of H_2, D_2, Ne and He as a function of pressure (10 mm.–10^{-3} mm.) at room temperature and at temperatures obtainable with liquid O_2 and H_2. In accordance with measurements on He, previously made [see Abstract 1878 (1938)] at liquid He temperatures, it was now possible to establish that for other gases at room temperature and at low temperatures η' as a function of p can be represented by the following formula: $\eta' = \eta p/(\eta a + p)$ (1), a is a parameter, which is only a function of the temperature and the molecular mass, η represents the real viscosity coefficient. Weber was able to deduce this formula theoretically [see Abstract 2758 (1939)]; the expression for a is found to be: $a = \frac{1}{2}k\sqrt{2\pi}(d_1 + d_2)/(d_1 d_2) \cdot (1/{}_1\rho_0)^{\frac{1}{2}} \cdot (T/T_0)^{\frac{1}{2}}$ (2), k is the accommodation coefficient, d_1 and d_2 the distances between the discs of the oscillating system of the apparatus, ${}_1\rho_0$ the density corresponding to 1 μ bar at 0°C. The experimental values obtained for a can be made to agree with the theoretical ones by taking $k = 1{\cdot}33$ at 90°K. for He and Ne, $1{\cdot}50$ at 20°K. and $1{\cdot}60$ at 15°K.; for H_2 and D_2 at the same temperatures $k = 1{\cdot}30$, $1{\cdot}65$ and $1{\cdot}85$. At room-temperature the authors encountered some difficulties (presence of Hg vapour and desorption of the molecules adsorbed on the discs). The experimental data obtained for a could be made to agree with the values computed from formula (2), by taking $k = 1{\cdot}33$. This is also the value found by Knudsen from his measurements. AUTHORS.

1436. Relation of fluidity to volume in organic liquids. E. C. BINGHAM AND P. W. KINNEY. *J. of Applied Physics*, **11,** *pp.* 192–202, *March*, 1940.—The Batschinski expression relating the fluidity of a compound to the specific volume at various temperatures is inadequate in the cases of associated compounds and those of high molecular weight. A modification, herein given, consists of the introduction of a correction term. The new expression, which relates linearly the fluidity and the corrected molecular free volume, has universal applicability and it holds with a high degree of precision. The constants of the new relationship are related to the complexity of the compounds in homologous series. From the constants given, the fluidity of undetermined members of the homologous series studied can be calculated if the density is known at that temperature. AUTHORS.

1437. Internal friction in solids. J. L. SNOEK. *Ned. T. Natuurk.*, **7,** *pp.* 133–146, *March*, 1940.—Several quantities which are a measure for internal friction in solids can be defined and their mutual relations are discussed. An important source of internal friction is the thermoelastic effect, i.e. local thermal currents, first discussed by Zener [see Abstract 3934 (1937)]. These currents may take place over relatively large distances, as in transversely vibrating bars, or over much smaller distances (as in neighbouring crystallites). In all cases the maximum losses are at frequency cDa^{-2}, where c is a constant of order unity, D the coefficient of heat conductivity, and a the mean distance between regions of unequal temperature. D. S.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1438. Spectrohelioscope with concave grating.** H. SIEDENTOPF. *Zeits. f. Astrophysik*, **19,** 2, *pp.* 154–155, 1939.—The Hale spectrohelioscope uses a plane grating. The use of a concave grating is preferable but in the ordinary Rowland mounting would give strongly astigmatic photographs; this disadvantage is overcome in an apparatus constructed by the author in which a concave grating is set up as first suggested by Runge and Paschen with the entry slit effectively at infinity by use of a collimator and observation of the spectrum in the neighbourhood of the normal to the grating. The collimator focal length is 2 m., the aperture 1/40 and first-order dispersion 8 Å/mm.; the radius of curvature of the grating is 3 m. and the ruled area 50×90 mm^2. The solar image is of 45 mm. dia. and an area of 10×12 mm. is scanned by a rotating prism; the same prism traverses the monochromatic light across the film, with magnification of 2 : 1 if desired, and accordingly a perfectly stationary image is produced. J. E. K.

See also Abstract 1554.

COMETS AND METEORS.

1439. Upper atmosphere densities and temperatures from meteor observations. F. L. WHIPPLE. *Popular Astron.*, **47,** [6 *pp.*], *Oct.*, 1939.—

The observations on which these results are based were obtained by synchronous photographs of meteor trails obtained with two cameras 38 km. apart. The principle of the method is that the integrated light of a meteor with a known velocity is a direct measure of the meteor's original mass, the instantaneous brightness being proportional to the rate of loss of meteoric matter. This rate of evaporation and therefore the luminosity, depends directly on the meteor's cross-section and the air density. Three methods of deducing this last are described. Preliminary results based on photographs of 23 meteors and their trails, of which, however, complete calculations for only 10 have been effected, point to most if not all meteors being members of the solar system. C. A. S.

1440. Luminescence and ionization of meteors. H. Nagaoka. *Imp. Acad. Tokyo, Proc.*, **15,** *pp.* 345–348, *Dec.*, 1939.—Arguments and calculations are adduced to show that the frequent appearance of meteors in the E-layer (at a mean height of 100 km.) is due to the pressure of the air at that height, which is estimated to produce a temperature of about 3 000°K. on the passage through it of the meteorite, such passage being accompanied by ionization and emission of electrons from its surface, thus producing the luminescence observed. [See Abstract 1479 (1935).] C. A. S.

COSMOGONY.

1441. Age of solar system. C. Popovici. *Comptes Rendus*, **210,** *pp.* 138–140, *Jan.* 22, 1940.—The upper limit deduced by the author for the age of the solar system by considering the secular variations in planetary orbits caused by radiation pressure from the sun [see Abstract 1030 (1940)] is modified when allowance is made for alterations in Mercury's rate of revolution over a period of centuries. This raises the limit from 22 to $25 \cdot 5 \times 10^{11}$ yr. A further modification to 18×10^{11} yr. results when the shortening of Mercury's period due to the sun's loss of mass by radiation is taken into account (this is assumed to be by a factor of 4 since Mercury was detached). The figure is finally put at 37×10^{11} yr. when allowance is made for the alteration introduced into the ratio of gravitational attraction and radiation repulsion by this alteration of the sun's mass. A. Hu.

See also Abstract 1415.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1442. Method of the variation of constants in celestial mechanics. J. Chazy. *Comptes Rendus*, **210,** *pp.* 156–159, *Jan.* 29, 1940.—Lagrange's differential equations for the osculating elements of the motion of a planet P about a centre O of Newtonian attraction are given a new form. The transformed equations are referred to rotating rectangular axes with origin at O of which OX is the line joining O to the ascending node of the orbit of P, OY is the normal to OX in the plane of the osculatory motion and OZ is normal to this plane. In addition to the six osculatory elements, the equations involve the vectorial velocity of P. G. C. McV.

LATITUDE AND LONGITUDE.

1443. Variation of latitude. H. Jeffreys. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 139–155, *Jan.*, 1940.—The international data on the variation of latitude have been analysed in accordance with the idea that the free motion is a damped one maintained by disturbances at irregular intervals of time. The results suggest a free period of $1 \cdot 22 \pm 0 \cdot 016$ years and a time of relaxation of $15 \cdot 1 \pm 1 \cdot 8$ years. There are notable irregularities in the motion, both in the harmonic coefficients and in the means taken over 1·2-year intervals, which occur in both the international and the Greenwich data. If of geophysical origin they imply changes in the products of inertia that are difficult to explain. The damping is too great to be attributed to friction in the sea, but might be due to elastic afterworking in the body of the earth. AUTHOR.

NEBULAE.

1444. Physical processes in gaseous nebulae. Part IX. Excitation of fractional multiplets by electron capture. G. H. SHORTLEY AND D. H. MENZEL. *Astrophys. J.*, **91**, *pp.* 307–319, *April*, 1940.—Observations show that certain permitted multiplets of O III and N III are not completely represented in the spectra of gaseous nebulae. Some mechanism apparently acts to give selective excitation of certain levels of a term, without exciting other levels. Bowen attributes the phenomenon to resonance absorption, principally of the ultimate line of He II, which happens to coincide with an ultimate line of O III. The absorptions originate from the highest, instead of the lowest, levels of the ground terms. Since these levels have mean lifetimes of the order of several hours, Bowen's theory requires the operation of some additional mechanism to maintain a sufficient population in the levels involved in the fluorescence process. Another method of excitation of fractional multiplets, direct electron capture by an ion in the ground level of a term (e.g. $^2P_{1/2}$ of O IV), is examined. The components predicted by quantum mechanics do not, however, agree with those observed in the nebulae. The conclusion is reached that Bowen is probably right, although a few discrepancies still remain unexplained. His method apparently requires inelastic electron impacts to be sufficiently frequent to maintain approximately a thermodynamic equilibrium population of atoms in the levels of the ground term. This paper includes the relevant quantum mechanical analysis of the relative probabilities of capture into the different levels of a configuration. [For Part VIII see Abstract 77 (1940).] AUTHORS.

1445. Relative populations of 2^1S and 2^3S states of He in the Orion nebula. O. C. WILSON. *Mt. Wilson Observat., Contrib. No.* 625. *Astrophys. J.*, **91**, *pp.* 360–362, *April*, 1940.—The observed equivalent width of λ 3 889 of He I produced by the Orion nebula, together with the absence of λ 3 965, leads to a lower limit for the ratio of populations of the 2^3S and 2^1S states of $N3/N1 \geq 25$. This is considerably in excess of the values calculated by Struve and Wurm on the assumption of strict metastability for both levels, and thus points toward a shorter mean life for 2^1S than for 2^3S. The matter may be complicated, however, by the selective absorption by the nebula of the light from the Trapezium stars. AUTHOR.

See also Abstract 1460.

PLANETS.

1446. Transits of Mercury. K. P. WILLIAMS. *Indiana Univ., Publ. Science Series, No.* 1, [70 *pp.*], 1939.—Le Verrier found in 1859 that Mercury's perihelion had a centennial motion of 38″·3 beyond its gravitational value, and Newcomb found this 43″·37 in 1898. The author discusses, in addition, Innes' work in 1925 on Mercury's transit, and Spencer Jones' work on fluctuations in the moon's longitude, which he changes into corrections to the observed instants of contact, for they are regarded as being due to errors in astronomical time; he presents it, however, in the form kt^2 and lets k be another unknown to be determined by the work itself. He finds that the solution for time corrected is so much better than for time uncorrected that the latter must be rejected. He investigates the corrections to the elements of Mercury's orbit, the radii of the sun and Mercury and mass of Venus. Some of Mercury's elements must remain indeterminate; for the sun and Mercury's semi-diameters, he gets 959″·54 and 3″·14 respectively, and for the mass of Venus 1/409 600, as against Newcomb's 1/408 000. A. S. D. M.

1447. Eccentricity of orbit of Pluto. H. ROURE. *Comptes Rendus,* **210,** *pp.* 136–137, *Jan.* 22, 1940.—The author examines the secular change in the eccentricity of Pluto's orbit brought about by the perturbing action of Neptune. The period is about 12 000 yr. A. HU.

STARS.

1448. Relative gradients of 250 stars determined at the Royal Observatory, Greenwich. *Roy. Astron. Soc., M.N.,* **100,** *pp.* 189–195, *Jan.,* 1940. —The present catalogue of spectrophotometric gradients of 250 stars continues the results given in *Observations of Colour Temperatures of Stars,* 1926–1932, and represents the completion of the Greenwich colour temperature programme. [See following Abstract.]

1449. Relations between colour indices and gradients. R. D'E. ATKINSON, A. HUNTER AND E. G. MARTIN. *Roy. Astron. Soc., M.N.,* **100,** *pp.* 196–212, *Jan.,* 1940.—Greenwich gradients are used as a basis of discussion of various colour-index lists. It is shown that the early B stars, normal and " reddened " together, should correlate linearly with gradients, with a slope that is calculable when the effective wavelengths in the colour-index work are known. The actual correlations are in fact linear, and the slopes probably fit the theoretical values: the true effective wavelengths however, are often in some doubt, and may depend themselves on the colour. The correlation for normal stars later than B3 may or may not be linear, and qualitative reasons are given for the forms of curve actually found; the difference between gradient and colour index is shown to be a measure principally of total H line absorption for types near A0. When all stars are taken together, the correlation is seldom single-valued, and the danger of using linear conversion factors from one system to another is pointed out. The desirability of an accurate determination of the sensitivity range of the instrument, in all kinds of magnitude work, is evident, and the need for monochromatic magnitudes for larger numbers of stars is also stressed. [See preceding Abstract.] AUTHORS.

1450. Spectrophotometry of early-type stars. D. BARBIER AND D. CHALONGE. *Comptes Rendus,* **210,** *pp.* 99–101, *Jan.* 15, 1940.—Mean spectrophotometric results are given, collected by spectral type, for 204 stars of types Oe5 to F8. The quantities listed are the absolute gradients, measured in the regions above and below the Balmer limit, the temperatures corresponding to these gradients, and the size of the Balmer discontinuity. The zero of the temperature scale above 3 700 Å is in agreement with that of other observers. For supergiants of type earlier than F5, the colour-temperature is the same as for normal stars; for later-type supergiants the temperature is lower than for normal stars. The Balmer discontinuity is smaller for stars showing emission lines than for those showing normal absorption; it may even become negative if the emission is strong. The colour-temperature varies according to the wavelength range in which it is measured; it increases towards the u.v. and suffers a sharp discontinuity at the Balmer limit. [See following Abstract.] A. Hu.

1451. Law of absorption by interstellar matter. D. Barbier and D. Chalonge. *Comptes Rendus,* **210,** *pp.* 166–168, *Jan.* 29, 1940.—The cause of the abnormal redness of certain early-type stars not showing emission lines is considered to be interstellar absorption. The authors examine how this absorption varies with the wavelength of the stellar radiation, by comparing the spectrophotometric results obtained for the reddened stars with those from normal stars of the same spectral type [see preceding Abstract]. This procedure is carried through for the stars ζ Pers, χ^2 Orio, and 9 Ceph by utilizing the authors' results in conjunction with those of other investigators at longer wavelengths. The functional form found for the absorption coefficient is not the same for all 3 stars but can be represented by a power series in $1/\lambda$ containing 2 or 3 terms; but not, as hitherto assumed, only one. It is possible that the form of the function depends on the direction in space from which the radiation is received. A. Hu.

1452. Temperatures of Cepheid variables SU Cassiopeiae and RR Lyrae. D. Norman. *Harvard Coll. Obs., Circ. No.* 434 [10 *pp.*], *rec. March,* 1940.—200 spectra of the Cepheid variables RR Lyrae and SU Cassiopeiae were obtained with objective-prism and slitless-grating spectrographs. The spectra were well distributed with respect to phase, completely covering the range of light variations. Each variable was compared with several reference stars, whose absolute gradients had been derived by comparison with standard stars selected from the Greenwich and Göttingen spectrophotometric lists. All plates were calibrated and standardized. Spectrophotometric gradients were determined for the wavelength region 4000 to 4700 Å by least-squares solutions. These gradients were reduced to temperatures on the assumption that the absolute gradient of an A0 star was 1·16, and corresponded to a colour temperature of 14300°. A marked difference is shown by both stars in the relation between temperature, spectrum, and magnitude on the ascending and descending branches of the light curve. The effective temperatures of the two stars were computed from the published radial-velocity and photometric data. The relationship between the observed colour temperatures and the computed effective temperatures is compared with Pannekoek's theoretical relationship, to which it bears some resemblance. Author.

1453. Transformations of matter-radiation gas mixtures. R. M. Whitmer. *Phys. Rev.,* **57,** *pp.* 516–521, *March* 15, 1940.—Emden found that for a perfect material gas, the transformations along the isochor, the adiabat, the isotherm and the isobar are all forms of the general polytropic transformation $\lambda = dQ/dT =$ const. An alternative definition of a polytrope is $\Gamma = -(dp/p)/(dv/v) =$ const. When radiation energy density and pressure are considered, it is found that λ is a constant only on the adiabat, and Γ only on the isobar. A discussion follows concerning the relation of these results to certain polytropic distributions of interest in astrophysics. Author.

1454. System of Procyon. E. Sevin. *Comptes Rendus,* **210,** *pp.* 163–165, *Jan.* 29, 1940.—The theoretical methods of Eddington and the empirical mass-luminosity relations given by Kuiper [see Abstract 167 (1939)] are used to study the components of the binary α C Min. The system resembles that of Sirius in that both primaries belong to the author's first evolutionary stage, and both secondaries to the second. The method of attack used predicts that the spectrum of Procyon B, as yet unobserved, will be found to be G2, and that the difference between the Einstein shifts of the two components will correspond to 12·7 km./sec. **Errata**, *ibid.*, *p.* 320, *March* 4, 1940. A. Hu.

1455. Variability of ι Herculis. W. Petrie. *Roy. Astron. Soc. Canada, J.*, **34,** *pp.* 41–48, *Feb.*, 1940.—The results of this investigation may be summarized briefly as follows: (i) ι Herculis varies in radial velocity over a range of approximately 15 km./sec., and should not be used as a standard velocity star. (ii) The radial velocities do not exhibit a short period variation of the kind typical of a β Canis Majoris star. (iii) The ratio of line intensities does not, according to these observations, vary in a period of 0·1434 days, and it is doubtful whether any real change in absorption is present in the data. Author.

1456. Survey of variable stars in MWF 186. H. H. Swope. *Harvard Coll. Obs., Ann*, **90,** 8, *pp.* 231–238, *rec. Feb.*, 1940.—In MWF 186 (galactic long. 322°.5, lat. 0°.0), 55 new variables have been discovered on 23 plates; a table is given of these, and of 46 previously known. Diagrams are given for the irregular variables H.V. 7869 and 7863, and for AH Scorpii, and mean light curves for some well-observed Cepheids, cluster-type variables, and eclipsing binaries; tables for 19 variables of previously known periods and types in the Field; and also for 101 variable stars. The mean maximum ($13^{m}\cdot 0$) of all variables in MWF 186 is brighter than for either MWF 187 ($14^{m}\cdot 2$) or MWF 185 ($14^{m}\cdot 6$), but is of the same order as for MWF 168 which also lies along the galactic equator; these two exhibit other similarities. Eclipsing variables and the irregulars are fairly evenly distributed over MWF 186. A. S. D. M.

1457. 400 new variable stars in a transparent low-latitude region. H. Shapley, E. H. Boyce and C. D. Boyd. *Harvard Coll. Obs., Ann.*, **90,** 9, *pp.* 239–251, *rec. Feb.*, 1940.—In MWF 269 (80 sq. deg., Gal. 307°, −20°), 400 new variables have been found in addition to 143 previously published; also 600 faint galaxies down to the 18th magnitude, indicating transparency in the region. Tables are given of new ranges and types for previously published variables; of a summary of the whole number of variables; of the percentages of types; of a catalogue with notes of the 400 stars (this is designed to give information on galactic and metagalactic structure). The magnitudes are based on sequences by star-counts and by transferring and extending existing sequences; there is probably little error in the magnitude scale, but it is perhaps appreciable in the magnitude zero-point. Approximate periods are found for 25 long-period variables, 8 eclipsing binaries, and 1 cluster-type variable. There is 1 classical Cepheid, with a median magnitude of 13·6 and of period nearly 10 days, absolute magnitude − 1·87 and distance = 3·8 kiloparsecs from the galactic plane. A. S. D. M.

1458. Cluster-type stars with changing periods. R. Prager. *Harvard Coll. Obs., Bull., No.* 911, *pp.* 1–11, *Aug.* 1, 1939.—Three cluster-type variables measured uninterruptedly over nearly 50 years, each show variable periods whose real character is the same for all three. (1) RZ Cephei, examined by Leavitt, Florja, Gaposchkin, and Luyten, shows two abrupt changes in the years 1894–1921. For the new discussion, about 1 550 Harvard Patrol plates were available, and confirm the existence of of a longer period in the years 1894–1901. A diagram and table indicate that three changes of period occurred. (2) Z Canum Venaticorum.

A table of maxima is given derived from about 1070 Harvard plates; the earliest Harvard maxima push back the observations into the past by nearly 10000 epochs, and show that from 1890 to 1912, as in recent years, there is no progressive change of period, but one rather sudden change about 1922 instead. (3) UY Bootis. This star's period underwent a considerable change about 1928. Tables and diagrams are shown for all 3 stars. A. S. D. M.

1459. Spectrophotometry of Nova Herculis in its intermediate stages. C. Payne-Gaposchkin and F. L. Whipple. *Harvard Coll. Obs., Circ. No.* 433 [6 *pp*.], *rec. March*, 1940.—The spectrum of Nova Herculis after the great minimum consisted of bright lines without an appreciable continuum. The relative intensities of the lines changed very little with time, except for the steady increase of the nebular lines N_1 and N_2. The colour index of the nova increased by over a magnitude during the fall of light, and decreased correspondingly during the rise. The phenomena of the great minimum and the concomitant reddening may be the results of obscuration. [See Abstract 1915 (1938).] Authors.

1460. Corrections to Dreyer's catalogues of nebulae and clusters. D. Carlson. *Mt. Wilson Observat., Contrib. No.* 526. *Astrophys. J.*, **91**, *pp*. 350–359, *April*, 1940.—Corrections to Dreyer's catalogues compiled from Mount Wilson plates and other photographic sources; 330 objects are to be dropped from the *New General Catalogue* (Table 1*a*) and 250 from the two *Index Catalogues* (Table 1*b*). Positions of 49 objects are corrected (Table 3), and the existence of 23 doubtful ones is confirmed (Table 4). Author.

See also Abstracts 1467, 1545.

SUN.

1461. Fine structure of sun's surface, M. Waldmeier. *Helv. Phys. Acta*, **13**, 1, *pp*. 13–15, 1940. *In German*.—Preliminary results of an investigation of solar granulation carried out at Zürich in the spring of 1938 are communicated in brief. In the centre of the disc the dimensions of the granulation elements lie between 1·1″ and 2·3″, their surface brightness is 30–40% greater than the brightness of the intergranular regions. The size of the granule is independent of distance from the centre of the disc but the contrast between granules and intergranular regions decreases from centre to edge. The granulation disappears at 70° from the sun's centre as expected on simple theoretical considerations. Granules persist for only a few minutes on the average. Faculae have a granular structure with more widely spaced granules than the disc but the same dimensions. The brightness contrast of faculae granules is greater than for disc granules and their life is of the order of a few hours. The presence of faculae granules has not yet been established at the centre of the sun. J. E. K.

1462. Solar eruptions. R. G. Giovanelli. *Astrophys. J.*, **91**, *pp*. 334–349, *April*, 1940.—Observations of 268 solar eruptions made with a spectrohelioscope during the period June, 1937, to Dec., 1938, have been analysed to show the relative distributions of intensities and areas. A simple photometer for the measurement of eruption intensity is described. The width of the Hα line during eruptions is constant for small intensities but increases rapidly when the intensity becomes equal to, and exceeds that of, the continuous spectrum. There appears to be no appreciable vertical velocity of the eruption itself. Approximately 20% of the eruptions eject eruptive prominences, and, assuming that this is caused by Lα

radiation pressure, the width of Lα is found to be approximately 6 times that of Hα when measured in velocity units. The position of eruptions in the chromosphere is discussed, and it is concluded that, in general, eruptions are confined to the levels in which the normal bright H occurs.
AUTHOR.

1463. He emission in solar chromosphere. T. HATANAKA AND M. KONDO. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp.* 105–115, *Jan.*, 1940.—The emission line of He was observed in the solar chromosphere without an eclipse with a special spectrograph constructed by the authors. A newly designed slit greatly facilitated observation. With the aid of an optical wedge and a He discharge tube, the profile of the line was determined by accurate photographic photometry. Necessary corrections due to geometrical and optical conditions were considered. The contour thus obtained was found to be very near the one which is broadened only by the Doppler effect, the mean velocity of which is the order of magnitude of 15 km./sec. Comparing the He line with the continuous spectrum at the centre of the disc of the sun, the authors determined, with necessary corrections, the radiation emitted by a column of unit cross-section to be $0{\cdot}94 \times 10^5$ erg/sec. and $0{\cdot}35 \times 10^5$ erg/sec. for the two limbs respectively. **Errata,** *ibid.*, **22,** *p.* 256, *March*, 1940. AUTHORS.

1464. Photometric observations of Hα in solar spectrum. D. S. EVANS. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 156–179, *Jan.*, 1940.—The contour of Hα has been measured at the centre and limb of the sun. New methods using the D lines of Na in absorption have been developed for the determination of the instrumental pattern and of the amount of scattered light. A new method of drawing characteristic curves has been used, and the continuous spectrum background has been estimated experimentally. The residual intensity has been found to increase at each wavelength in the line as the limb is approached. Unsöld's suggestion that the Balmer series is formed effectively by pure absorption is criticized and a new equation of transfer proposed. Some evidence is found in support of the view that uncompensated cycles are not of importance in the formation of Hα.
AUTHOR.

1465. Energy distribution in solar spectrum. A. ARNULF, D. CHALONGE AND G. DÉJARDIN. *Comptes Rendus*, **210,** *pp.* 325–327, *Feb.* 26, 1940.—The spectrum of integrated sunlight between 4 500 and 3 300 Å has been examined at the observatory on the Jungfraujoch (3 575 m.) by means of a quartz two-prism spectrograph used without a telescope or heliostat. On each photographic plate was recorded a series of 6 solar spectra taken through platinized quartz filters, previously calibrated, and the spectrum of a H-tube. Atmospheric absorption was corrected for by night observations on two stars. Photometric comparisons were subsequently made between the solar spectrum and the H spectrum at 66 points between 4 538 and 3 290 Å chosen for their freedom from Fraunhofer absorption. A single colour temperature of 6 200°K. is found to represent the observations in this region. This figure corresponds to a value of 6 600°K. at the centre of the solar disc. A. HU.

1466. Rowland intensity scale. D. H. MENZEL, L. GOLDBERG AND E. M. COOK. *Astrophys. J.*, **91,** *pp.* 320–333, *April*, 1940.—A new calibration of Rowland's scale of solar intensities has been derived with the aid of the theoretical strengths of multiplets in transition arrays. The calibration takes the form of a double-entry table giving average values of log X_0 where X_0 is the optical depth at the centre of an absorption line for each

Rowland intensity from − 3 to + 8 at intervals of 400 Å from λ 2 800 to λ 6 800. A total of 37 transition arrays, representing 13 metallic elements and 1 119 lines in all, was employed in the analysis. The present calibration is considerably less steep than the earlier one of Russell, Adams, and Moore. AUTHORS.

1467. Point-convective model for the sun. R. E. MARSHAK. *Astrophys. J.*, **91**, *pp.* 362–364, *April*, 1940.—The internal temperature, density, and mass distributions of the sun have been calculated on the basis of the point-convective model, using tables of Strömgren and the Kramers' opacity law. These tables are more extensive than Cowling's and are useful for investigations into the energy production of main-sequence stars more massive than the sun. AUTHOR.

See also Abstract 1485.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

1468. Submarine illumination in photometric units. C. L. UTTERBACK AND R. E. WILSON. *J.O.S.A.*, **30**, *pp.* 136–139, *March*, 1940.—The paper describes a method of obtaining underwater illumination in photometric units. The results are given as total horizontal illumination at different depths and as cell-current extinction coefficients of two bands in the visible spectrum. The effect of temperature on the submerged photometer is indicated, and a mean temperature coefficient between 0°C. and 17°C. is calculated. AUTHORS.

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1469. Currents of Pacific Ocean and climates of its coasts. H. U. SVERDRUP. *Science*, **91**, *pp.* 273–282, *March* 22, 1940.—In Aug. the atmospheric movements are dominated by two high pressure systems, one to the N.E., the other to the S.E., with clockwise and anti-clockwise circulations in the northern and southern hemispheres respectively. In Feb. the northern system, has moved closer to the Aleutian Ids., while a smaller system off the Californian coast has appeared, the southern, nearer the South American coast. The prevailing currents deviate to the right of that of the prevailing wind in the northern, to the left in the southern hemisphere. In addition the east-to-west equatorial current, fundamentally due to the rotation of the earth brings warm water to the western shores, which on reaching them turns N. and N.E. finally reaching and bringing warmth to southern Alaska and British Columbia. This is compensated by a polar current bringing cold water along the west coast of S. America, and by the upwelling of cold water from greater depths. These and many subsidiary connected facts are illustrated by diagrams and described in detail. C. A. S.

1470. Equations of flow of water over a mobile bed. C. JAEGER. *Comptes Rendus*, **210**, *pp.* 472–474, *March* 27, 1940.—The author, in a previous paper (*Wasserkraft u. Wasserwirtschaft*, 1939, *Nos.* **23–24**, *p.* 269), found that, contrary to the conclusion of Veronese, the empirical formula for the erosion of a bed by a stream of water does conform with Froude's law of similitude. This conclusion is now confirmed, and it is suggested that the law proposed by Meyer-Peter, Favre and Einstein relating to the transport of solids possesses the characters of a physical law. [See Abstract 1060 (1940).] J. S. G. T.

1471. Effect of short-period variations of temperature and salinity on calculations in dynamic oceanography. H. R. SEIWELL. *Physical Oceanography and Meteorology, Papers,* **7, 3,** [32 *pp*.], *Nov*., 1939.—Possible discrepancies in computations of ocean currents (based on horizontal variations of dynamic topography calculated from arbitrary deep lying reference surfaces), because of time variations of temperature and salinity at fixed depths in the sea are discussed. The results are based chiefly on information from the western North Atlantic, but are of general applicability, since time variations of the same order of magnitude have been observed over extensive areas of the Atlantic Ocean. Details are given of short-period variations of temperature, salinity, and of volume transport of water in the Western Sargasso Sea. Within the Gulf Stream off the American coast the observed short-period variations of oceanographic characteristics were of larger magnitude but because of the greater slope of isobaric surfaces the consequence to dynamic calculations is relatively less. These variations may arise from short-period vertical and/or horizontal displacements of water particles from mean positions or from vortex motion of the water. Their relative values are discussed. In the western Atlantic, east of the Gulf Stream, vertical oscillations are the chief cause. The need for control in the selection of oceanographic data is explained. Observations on internal waves appear to indicate 12 and 24 lunar hour periodicities and probably also 8 and 2·25 hours. Existing information seems to indicate that the disturbances due to internal waves is insufficient to invalidate computation of the broad general features of ocean currents by the dynamic method of V. Bjerknes. R. S. R.

1472. Changes in salt content in the ocean caused by precipitation and the restoration by turbulence. A. DEFANT AND H. ERTEL. *Preuss. Akad. Wiss. Berlin, Abhandlungen,* *No*. 10, [10 *pp*.], 1939.—The lowering of salt concentration extends during precipitation by turbulence to lower layers while after precipitation finishes the restoration of salt concentration is propagated upwards. A theoretical treatment of the problem is given. Observations were made from the Carimaré in the early summer of 1938 in 38°N. and 42° 25′W. and the results agree with theory within the limits of experimental error. The results are of importance to know how far determinations of surface salt content at one station can be considered representative if precipitation has occurred at that point a certain time earlier. R. S. R.

See also Abstracts 1484, 1496, 1497.

LAND, PHYSICS OF THE.

1473. Internal energy of the earth. F. SBRANA. *Pont. Acad. Sci., Acta,* **3,** 9, *pp*. 65–67, 1939. *In Italian*.—It is shown that the earth loses daily 1 000 cal./cm^2. through the contraction of the earth's core if the viscosity coefficient is taken to be of the order 10^{20} c.g.s. units in the interior of the earth. L. K.

See also Abstracts 1374, 1399, 1637.

METEOROLOGY.

1474. Ozone clouds. F. W. P. GÖTZ. *Helv. Phys. Acta,* **13,** 1, *pp*. 3–5, 1940. *In German*.—It is suggested that the ozone layer above a given place on the earth's surface may be in the form of clouds with clear spaces in between. Measurements of the amount of ozone above Arosa showed that on Sept. 30, 1939, the amount was constant (0·206 cm.) from 7^h to 18^h. On Sept. 11, 1939, there was a minimum of 0·183 cm. at about 8^h and a steady rise to 0·195 cm. at 1430^h. On July 28, 1939, there were great fluctuations all day. The amount at 7^h was 0·245 cm., which rose to 0·256 cm. and fell again to 0·240 cm. by 8^h. This phenomenon is interpreted as due to an ozone cloud to the East of Arosa some 100 km. in extent. G. C. McV.

1475. Tables and graphs of the black-body radiation for meteorological use. K. Terada. *Geophys. Mag., Tokyo,* **13**, *pp.* 137–143, *Dec.,* 1939.—Planck's formula for black-body radiation is used to construct a table and nomograph for calculations. The values of λ_m, E_m and E are calculated and tabulated for the range − 99°C. to 99° C. The nomograph constructed by Mizuno for high temperatures and short wavelengths is used for the range required in meteorology by applying suitable correcting factors to T, λ and E_λ. A nomograph has also been calculated for large values for λ. R. S. R.

1476. Pressure and temperature variations in the free atmosphere over Boston. B. Haurwitz and E. Haurwitz. *Harvard Meteorolog. Studies, No.* 3, [74 *pp.*], 1939.—The observations consisted of radio soundings made over Boston in Feb. and March, 1937, and from Oct. 1937, to June, 1939, the pressures and temperatures at various heights being determined. The interdiurnal pressure variations (regardless of sign) decrease more rapidly up to 2 dyn. km. than over Europe. The temperature variations has a slight maximum at 1 dyn. km. and from 3 dyn. km. remains constant up to 6 dyn. km. It rises to a sharp maximum at 9–10 dyn. km. It was also found that the mean algebraic pressure variations change sign near the tropopause. When the pressure and temperature variations at the surface are of opposite sign, the pressure variation rapidly decreases with height and changes sign at 5 dyn. km. When the signs are the same, the pressure variation increases with altitude. Correlation coefficients are positive between the mean temperature of the troposphere and the pressures at 3, 5, and 9 dyn. km. and between these pressures and the height of the tropopause. When referred to location in isallobaric highs and lows, the observations show that the maxima and minima of the pressure variations are displaced to the rear whilst those of temperature are displaced forwards relatively to the state of affairs at the surface. These phenomena are explicable both on the theory of stratospheric steering and by the wave theory of cyclones. The advection of air is discussed on the basis of a method of calculating the pressure "following the motion". Advection is found to be most active near the surface and near the tropopause. G. C. McV.

1477. Distribution of temperature in the lower stratosphere. M. W. Chiplonkar. *Indian Acad. Sci., Proc., Sect. A;* **11**, *pp.* 39–52, *Jan.,* 1940.—An analysis is made of all sounding balloon ascents, made in different parts of the world, which attained levels higher than 24 or 25 km. It was found that, in the tropics, the rise of temperature between 18 and 25 gkm. is a permanent feature. In temperate latitudes the rise of temperature above 18 or 20 gkm. is much weaker and is absent in winter. In polar regions there is a large seasonal variation of stratospheric temperature. In summer there is a rise of temperature with height roughly similar to that of temperate latitudes but in winter there is a definite fall of temperature with height. The increase of temperature in the stratosphere is probably due to the absorption of the incoming solar radiation by an ozone layer at 22 km., together with the radiative equilibrium between water-vapour and long-wave heat radiation. G. C. McV.

1478. Ten years large-scale weather investigation. H. PHILIPPS. *Naturwiss.*, **27**, *pp.* 825–834, *Dec.* 15, 1939.—A review is provided of ten years activity in the preparation of 10-day forecasts at Hamburg. The factors involved include the determination of mean pressure distributions, the tracks of depressions, and the causes of variations in them. This in turn requires a 3-dimensional view with use of charts of pressure at 5 km. From the mean pressure distribution at 5 km. large-scale changes result and the causes of changes and their movements at this level are required. Singularities are important. Solar radiation and geophysical phenomena also play a part. The process consists in obtaining first monthly values of solar changes, next consideration of all upper weather phenomena and lastly factors involving the general atmospheric circulation. Statistical methods involving correlation coefficients are used and are based on observations extending over 46 years. The correlation method used is explained. From changes of iso-correlations a series of influences is obtained. The synoptic method using rhythm, symmetry and upper weather is then applied. Finally type correlation has been introduced as a further advance. R. S. R.

1479. Seasonal variation of general circulation in light of circulation principle. H. ARAKAWA. *Geophys. Mag., Tokyo*, **13**, *pp.* 145–148, *Dec.*, 1939.—Making use of the form of the circulation principle developed by Bjerknes an expression is obtained which permits of a quantitative determination of the rate of increase of circulation which any distribution of temperature and potential temperature will cause. This is applied to the general circulation of the hemispheres between tropical and polar regions. It is shown that the general circulation in winter is far more intense than in summer. R. S. R.

***1480. Experimental studies of anemometers.** S. P. FERGUSSON. *Harvard Meteorolog. Studies, No.* 4, [101 *pp.*], 1939. *Am. Meteorolog. Soc., Bull.*, **20**, *pp.* 307–309, 1939.—The investigation was undertaken in order to evaluate the scales and sensitivities of anemometers principally of the cup and mill types. The experiments were carried out in wind tunnels as well as in the natural wind. With regard to rates, it was found that differences between large and small tunnels and between tunnels and the natural wind were largest at low and moderate velocities. The effects of bracing the arms in cup anemometers were studied. Examination of the results for the 4-cup and 3-cup standards suggests that a correction of 0·1 m./sec. should be applied for velocities below 15 m./sec. It was found that 3-cup anemometers gave a better performance than 4-cup but the greatest improvement suggested was the beading of the edges of the cups. With regard to constancy of rates, it appeared that compactness in a Robinson anemometer was desirable and that the rate of this anemometer was higher in a variable than in a steady wind. The rates of 3-cup anemometers were more nearly constant than those of 4-cup of the same proportions. As to sensitivity, a light rotation anemometer acquires a new velocity in 2·5 sec. at a velocity of 5 m./sec. and in 0·3 sec. at 30 m./sec. or higher. The number of rotations required is, however, constant at all velocities. The most sensitive anemometer discovered was the balsa-wood mill. The data of all the experiments are given in detail and suggestions for the design and construction of anemometers are given. The necessity of a standard definition of velocity, based on the period of time occupied by a measurement and the frequency of registrations by the sensitive element, is emphasized. G. C. McV.

1481. Cirrus, Cirrostratus and Terada's experiments on columnar vortices. Y. TAKAHASI. *Geophys. Mag., Tokyo,* **13,** *pp.* 149–153, *Dec.*, 1939.—It is stated that in the free air columnar vortices can be produced under some unstable conditions and that the patterns obtained experimentally by Terada were shown in cirrus and cirrostratus. A photograph of one example of vortical structure in cirrostratus is shown while for a time a spiral structure was visible in this cloud. R. S. R.

1482. Cloud heights at Poona, Bombay and Madras. K. P. RAMAKRISHNAN. *India Meteorolog. Dept., Sci. Notes,* **8,** 85, *pp.* 17–22, 1939.—Statistics of low cloud heights at Bombay and Poona during the southwest monsoon season and at Madras during the northeast monsoon season at different parts of the day are given in the form of frequency tables. The measurements were made either by " ceiling " or by " pilot " balloons and extended over three or four years. For Poona observations made at night by using a searchlight are also given. Some examples of short period fluctuations in cloud heights are also shown from these searchlight measurements. AUTHOR.

1483. Duststorms of Agra. B. N. SREENIVASAIAH AND N. K. SUR. *India Meteorolog. Dept., Mem.,* **27,** 1, [29 *pp.*], 1939.—In Part I of the paper are discussed the monthly and hourly frequencies as well as other characteristics shown by autographic charts in regard to wind, temperature, pressure and humidity of 152 duststorms which occurred at Agra between 1924 and 1930. The maximum frequency of duststorms is seen to be in May, June following with a slightly smaller number ; there is a maximum frequency of duststorms between 16 and 18 hours. Part II of the paper discusses the mechanism of duststorms with particular reference to the thermodynamics thereof, with the help of a few special sounding balloon ascents made in the summer of 1932 and other available soundings. The general conclusion which the study points to is that the occurrence of a duststorm is mostly associated with the existence of latent instability conditions in the atmosphere ; while this seems to be a necessary condition, it does not appear to be sufficient to cause the phenomenon unless there is a suitable trigger to start it. Six cases have been examined and discussed in detail ; in these cases, either isolation leading to a high lapse rate of temperature above ground or undercutting by cold winds, associated with a general or local cold front, acted as a trigger to release the energy of latent instability shown by the environmental curves on these days, resulting in either a duststorm or a duststorm associated with a thunderstorm. AUTHORS.

1484. Vertical humidity distribution above the ocean surface and its relation to evaporation. R. B. MONTGOMERY. *Physical Oceanography and Meteorology, Papers,* **7,** 4, [30 *pp.*], *Feb.*, 1940.—To obtain information on the effect of eddy viscosity and eddy diffusion at the boundary between sea and atmosphere simultaneous measurements of humidity in the range 1 to 38 m. above the sea surface were made from " Atlantis " during its cruises off the east coast of U.S.A. in the summer of 1935. The 340 series are published in the form of averages for 115 ten-minute intervals. Measurements were made with three Assmann psychrometers and a hygrothermograph. The observations follow a logarithmic distribution. The

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194

theoretical treatment is set out. The vertical humidity gradient was expressed as the non-dimensional quantity Γ. The humidity gradients depended on the hydrodynamic character of the sea surface and on spray and these depend on wind speed and thermal stability. The transition from smooth to rough hydrodynamic surfaces appears to depend more on stability than on wind speed. The effect of this hydrodynamic character of the surface is shown graphically. The rate of evaporation is given as $E = \kappa_0 \gamma_a \Gamma (q_s - q_b) W_a$, where ρ is air density, κ_0 is the universal turbulence constant, q_s is the specific humidity of saturation with respect to the sea surface, q_b is the humidity at height b, and W_a is the wind speed at height a. [Both γ_a, the coefficient of resistance, and Γ which may be called the "evaporation coefficient" depend on the hydrodynamic character of the surface, but their product is about the same for smooth or rough surfaces. Using observed values of the evaporation coefficient from heights above the layer where vapour is released from spray, the equation gives the total evaporation. R. S. R.

1485. Relation of sunspot periodicity to precipitation, temperature, and crop yields in Alberta and Saskatchewan. L. P. V. JOHNSON. *Canad. J. of Research, C,* **18,** *pp.* 79–91, *March,* 1940.—Coefficients of correlation (r) were calculated for sunspot data as related to annual precipitation and to temperature data from Edmonton, Calgary, Medicine Hat, Swift Current, Battleford, and Qu'Appelle; and as related to data on the yields of wheat, oats, and barley in Alberta and Saskatchewan. In all cases the correlation was negative, but only in the cases of precipitation at Edmonton, Calgary, and Battleford were the values significant. Data giving significant values of r are given graphical treatment. It was concluded that while the sunspot cycle probably bears some causal relation to precipitation, and perhaps also to temperature and indirectly to crop yield, it, nevertheless, does not provide a basis for long-range weather forecasting owing to the confusing effects of other weather-determining factors. The literature on sunspot periodicity in relation to terrestrial phenomena is reviewed briefly. AUTHOR.

1486. Transparency of the atmosphere. "White mist". J. DUCLAUX. *J. de Physique et le Radium,* **1,** *pp.* 41–43, *Feb.,* 1940.—Atmospheric absorption is often treated as if composed of two factors, viz., molecular diffusion, together with a "white mist", which would make objects less visible but would not affect their colour. The latter conception is now criticized, and shown to be invalid, in the light of normal photographic experience in the use of colour filters, and of specially designed quantitative experiments, which all indicate that such a mist would absorb short wavelengths more strongly than long ones. [See Abstract 4264 (1939).] C. B. A.

***1487. Radiative properties of the snow cover.** F. PROHASKA AND C. THAMS. *Helv. Phys. Acta,* **13,** 1, *pp.* 21–45, 1940. *In German.*—The radiative properties of the snow cover were investigated at Davos for the whole period Dec., 1938, to April, 1939. These properties were found to be very complicated depending upon the kind of snow. Two solarimeters were employed and details are given of the apparatus and method used. The albedo oscillations are considerable varying from 80% for new dry snow to 50–60% for wet snow. The transmission of radiation has more pronounced variations being very high for new dry snow and rapidly decreasing as the snow becomes wet. The results obtained are in good agreement with earlier Davos measurements and with those of other investigators and are considered to be characteristics of alpine snow and probably also of that elsewhere. R. S. R.

1488. Night-sky light and nocturnal E-layer ionization. N. E. BRADBURY AND W. T. SUMERLIN. *Terr. Mag.*, **45**, *pp.* 19–24, *March*, 1940.—In accordance with the suggestion that the sporadic nocturnal E-layer ionization may be associated with variations in the luminosity of the night sky, a simultaneous investigation of both these phenomena has been carried out. The intensity of night-sky light was determined by means of a recording electrometer and photocell, measurements being made only after twilight and during such times as the moon was below the horizon. At different times both a Kunz KH-cell and a CeO-cell were employed. The ionosphere was investigated simultaneously using a pulse-transmitter and photographically recording receiver operating at a frequency of 2·1 Mc./sec. The blue portion of the night-sky luminosity appears to increase after sunset to a maximum shortly after midnight with a subsequent slow fading. The light in the red region of the spectrum shows much greater fluctuations in intensity and is brightest after sunset and decreases continuously thereafter. Practically no correlation has been found between the intensity of the night-sky light and the character of the ionospheric reflection. Various possibilities may be suggested to explain this result. AUTHORS.

See also Abstracts 1439, 1469.

SEISMOLOGY.

1489. Seismic waves at large distances in the North Chile earthquake, Feb. 23, 1933. Part I. Travel times. M. MORITA AND Y. YOSIMURA. *Geophys. Mag., Tokyo*, **13**, *pp.* 163–191, *Dec.*, 1939.—The travel times were obtained from data of the North Chile earthquake of 1933. The authors note that the strong emergence of the P'_2-phase, often observed in Europe and America, is less common in Japan. In the range 146°–160° the slope of the P'_1 curve agrees with Macelwane's, but beyond that the curve is at present uncertain. The time-curve of the L-phase has a slope similar to Macelwane's. These L-times have, however, an inexplicable peculiarity, viz. the times in Japan are quite different before and after a distance of 152°. W. A. R.

1490. Diffraction of a perturbation near a caustic: Application to P′ waves. J. COULOMB. *Seismological Soc. of America, Bull.*, **30**, *pp.* 27–34, *Jan.*, 1940. *In French.*—The problem of diffracted P′ waves is considered on the basis of a theory of caustics [see Abstract 3218 (1938), with special reference to seismic perturbations. A very approximate theory is developed and leads to a hodograph in disagreement with available data for seismic waves, making the existence of a focal point doubtful. To adapt the hodographs to the theoretical position would involve submitting those of P'_2 and P'_1 to an exaggerated deformation. Hence it may be necessary to abandon the idea of a focal point and to explain otherwise the observed amplitudes. N. M. B.

1491. Period of P-waves and magnitudes of earthquakes. H. HONDA AND H. ITO. *Geophys. Mag., Tokyo*, **13**, *pp.* 155–161, *Dec.*, 1939.—A comparison of the periods of the initial motion of the P-waves with the magnitudes of the earthquakes for 12 deep-seated earthquakes of considerable intensity shows that the period increases with the intensity, the curves relating them being approximately parabolic. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1492. Biannual component in F_2-layer ionization. T. L. ECKERSLEY. *Terr. Mag.*, **45**, *pp.* 25–36, *March*, 1940.—Apart from speculations, it may be said that the midday densities at Washington and Watheroo can be expressed very clearly as the sum of two main parts :—(*a*) A secular effect proportional to the Wulf sunspot-number. (*b*) Fluctuation effects. These latter can be analysed into three parts : (1) A seasonal effect dependent on the sunspot-number ; (2) a biannual effect proportional to the sunspot-number ; (3) an annual effect independent of the sunspot-number. It is suggested that the biannual effect is associated with the distribution of sunspots on the surface of the sun, the sunspots being grouped about two latitudes north and south of the sun's equator and the sun's axis being tilted towards the ecliptic ; while the annual effect may be produced by extra-terrestrial radiation originating in the galaxy. Further work is required to see how these effects vary diurnally and with latitude, and possibly magnetic latitude. The results of such work will give hints as to the origin and nature of the three components, which will conform or modify the tentative explanations put forward as a deduction from the analysis of the present limited results available, but there does not seem to be any reasonable doubt that the three components really exist, whatever further light may be thrown on their nature and origin. AUTHOR.

1493. F_2-region ionization over New Zealand. F. W. G. WHITE, C. J. BANWELL AND G. A. PEDDIE. *Terr. Mag.*, **45,** *pp.* 37–43, *March*, 1940.—In these latitudes the diurnal curves did not show a marked morning and afternoon maximum in the values of the critical frequency in the F_2-region, $f°_{F_2}$. In summer the daylight level of this quantity was maintained until well after sunset. The annual variation showed a pronounced minimum in the summer months and in the winter months. The maxima in $f°_{F_2}$ occurred in April, 1938, and in Sept., 1938. The April maximum was higher than that in Sept. The annual curve was similar in form to that found at other stations in the southern hemisphere but there appears to be no regular variation with latitude. The day-to-day fluctuations in $f°_{F_2}$ are found to be similar at Christchurch and Wellington on the majority of days ; on certain days, however, there is a marked difference in $f°_{F_2}$ at these two stations. The cause of this difference is at present unknown but it is evidently not connected with magnetic activity for such activity affects both stations similarly. AUTHORS.

1494. Report on work in terrestrial magnetism and electricity in U.S.S.R. during 1936-1939. P. P. LAZAREV, N. I. LEUSCHIN, N. N. NIKOLSKY, N. V. PUSHKOV AND N. N. TRUBYATCHINSKY. *Terr. Mag.*, **45,** *pp.* 71–76, *March*, 1940.

***1495. New magnetometric apparatus for measuring the vertical component of the earth's field.** G. VALLE AND G. TRIBULATO. *N. Cimento*, **16,** *pp.* 441–446, *Nov.*, 1939.—An apparatus is described for determining the vertical component of the earth's field by compensating it exactly with an opposing auxiliary magnetic field. The attainment of exact neutralization is determined by the absence of movement in a ferromagnetic wire carrying an alternating current. The method is capable of considerable accuracy. [See Abstract 774 (1933).] S. J. G.

See also Abstracts 1488, 1670 and

717B. Wave shapes of successive lightning current peaks. K. B. McEachron.

RADIOACTIVITY.

1496. Radioactivity of mineral waters of Châtel-Guyon (Puy de Dôme). A. Lepape and M. Geslin. *Comptes Rendus*, **210**, *pp*. 223–225, *Feb*. 5, 1940.—The Rn content of the gases and mineral waters of various springs is measured and it is found that the ratio of Rn in the water to that in the gases varies from spring to spring and indicates that the equilibrium ratio of the solubility in gas and water is not always reached on emergence. The waters near the surface are richer in Rn than those from a greater depth. The Tn content of one of the springs at Châtel-Guyon was many times greater than that of one at Vichy, but relative to the MsTh1 content it was only half that of the Vichy Spring. Possible reasons for this are given. W. E. D.

1497. High proportions of MsTh1 in mineral waters (Puy de Dôme). R. Duchon. *Comptes Rendus*, **210**, *pp*. 225–228, *Feb*. 5, 1940.—The MsTh1 content of several springs is measured by passing a current of gas through the waters and then into an electroscope. It is found that the waters contain no Th or RdTh but only MsTh1, that the waters of Châtel-Guyon are richer in this than those of other springs in the vicinity, and that the water of Martres d'Artières contains about seven times as much Ra as the water of Châtel-Guyon. W. E. D.

1498. Neutrons from a Ra-Be source. Z. Ollano. *N. Cimento*, **16**, *pp*. 456–458, *Nov*., 1939.—Experiments on the yield of neutrons from Ra-Be and Rn-Be sources show that the apparent inefficiency of the former arose from incomplete mixing of the Be and Ra salt. F. C. C.

1499. Liberation of fast neutrons in the nuclear explosion of U irradiated by thermal neutrons. T. Hagiwara. *Kyoto Coll. Sci., Mem.*, **23**, 1, *pp*. 19–32, 1940.—Fission neutrons liberated from U under neutron irradiation are investigated with respect to the separate effect due to thermal neutrons alone. U_3O_8 was either screened from primary thermal neutrons or exposed to them by use of a Cd shield interposed between the neutron source and U_3O_8. The comparison between the photographically recorded counts of neutrons measured with and without the Cd shield allowed the author to detect and measure the net gain in the number of fast neutrons released. By a number of sets of such alternating measurements it was possible to ascertain the remarkable net increase of secondary fast neutrons caused by absorbing the thermal neutrons alone. In this way, the average number of fast neutrons liberated per fission of U induced by thermal neutrons was found to be 2·6. From considerations of the order of the amount of energy—about 10 eMV—involved in the fission neutrons, it is probable that the neutron release takes place immediately after the main division of the compound nucleus instead of simultaneously with the explosion. Author.

1500. β-radioactivity of Re. F. Yamasaki and K. Sinma. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No*. 950, *pp*. 10–16, *Jan*., 1940. —A study has been made of radioactivities induced in Re by bombardment with neutrons. The active substances were identified with Re isotopes by chemical separations. The decay curve has been analysed into two components with half-lives of 16 ± 1 and 90 ± 2 hr. These two periods have been found to be associated with Re^{188} and Re^{186} respectively. The energy upper limits deduced from K-U plots obtained with the Wilson cloud chamber method were found to be 1·2 eMV for Re^{186} (e^-) and 2·5 eMV for Re^{188} (e^-). Authors.

1501. β-rays from radioactive isotopes, Ni^{63}, Zn^{63}, Zn^{65}, Zn^{69}, Zn^{69*}, Ga^{68}, Ga^{70}, Ga^{72}, Ge^{71}, Ge^{75} and Ge^{77}. R. SAGANE, S. KOJIMA AND G. MIYAMOTO. *Phys. Math. Soc. Japan, Proc.*, **21,** *pp.* 728–742, *Dec.*, 1939.—The β-ray spectra of Ni^{63}, Zn^{63}, Zn^{65} Zn^{69} (57 m.), Zn^{69*} (13.8 h.), Ga^{68}, Ga^{70}, Ga^{72}, Ge^{71}, Ge^{75} and Ge^{77} have been investigated by measuring the curvature of the tracks in a cloud chamber situated in a known magnetic field. The upper limit derived from K-U plots are summarized as follows:

Ni^{63}	Zn^{63}	Zn^{65}	Zn^{69}	Zn^{69*}	Ga^{68}	Ga^{70}	Ga^{72}	Ge^{71}	Ge^{75}	Ge^{77}
2·5 h. e^-	35 m. e^+	210 d. e^+	57 m. e^-	13·8 h. e^-	66 m. e^+	20 m. e^-	14 h. e^-	26 h. e^+	81 m. e^-	8 h. e^-
1·65	1·92	0·37	0·99	0·99	1·37	1·68	1·71	1·15	1·10	1·92
0·67	—	0·19								

From the consideration of energy balance, the minimum neutron energies to produce neutron loss processes for Cu^{62}, Zn^{63} and Ga^{68} are estimated roughly to be 12.7, 9.8 and 9.0 eMV respectively, which are in good agreement with the values reported by one of the authors except the last case. [See Abstract 642 (1939).] AUTHORS.

1502. Radioactive ^{65}Zn. Y. WATASE, J. ITOH AND E. TAKEDA. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp.* 90–105, *Jan.*, 1940.—Long-period activity of ^{65}Zn was obtained by deuteron bombardment of brass. Radiations from it were investigated by cloud chamber and also by counters, with the following results: ^{65}Zn decays by K-electron capture as well as by positron emission to ^{65}Cu, the probability of the former being about 80 times larger than the latter. The maximum energy of positrons was 0·47 eMV. Intense γ-rays whose energies are 1·0, 0·65 and 0·45 eMV respectively, accompany the K-electron capture. Primary electrons of continuous spectrum and internal conversion electrons were not found. By counter coincidence measurements, positron-γ, K-X-ray-γ, and γ-γ coincidences were observed, and a tentative level scheme is discussed. AUTHORS.

1503. Production of RaE and RaF (Po) from Bi. J. M. CORK, J. HALPERN AND H. TATEL. *Phys. Rev.*, **57,** *pp.* 371–372, *March* 1, 1940.—It is shown that when Bi is bombarded with 10-eMV deuterons both RaE and RaF are formed. The former corresponds to a neutron capture and the latter to the capture of a proton. The yield of each product is found as a function of the exciting energy. At 10 eMV the yield of RaF is less than 0·25 of that of RaE. Since the possibility of a neutron and a proton leaving the nucleus should be almost equally probable, this is evidence that the deuteron as a whole has a low probability of entering the nucleus but rather obeys an Oppenheimer-Phillips process. The cross-sections for the formation of RaE and RaF at 10 eMV are 4×10^{-28} cm^2. and 9×10^{-29} cm^2., respectively. AUTHORS.

1504. Radioactive isotopes of Te. G. T. SEABORG, J. J. LIVINGOOD AND J. W. KENNEDY. *Phys. Rev.*, **57,** *pp.* 363–370, *March* 1, 1940.—Three pairs of radioactive Te isomers have been studied with the help of a chemical method for separating the isomers. In the case of each pair of isomers it was found that the longer-lived activity constitutes an isomeric transition from an upper to a lower level in the Te nucleus, and that the shorter-lived activity is due to β-particle decay from the lower level to an iodine isotope. It has been possible to make isotopic assignments for these three pairs of isomers and also for a seventh (single) Te activity. The data are collected in the following table :

Active Isotope	*Half-Lives*	*Methods of Production*
Te^{131}	$1 \cdot 2 \pm 0 \cdot 2$ days $\rightarrow 25 \pm 5$ min. $\rightarrow I^{131}$ (8 days) $\rightarrow Xe^{131}$	$Te(d,p)$; $Te(n,\gamma)$; $U(n, -)$
Te^{129}	32 ± 2 days $\rightarrow 72 \pm 3$ min. $\rightarrow I^{129}$(?)	$Te(d,p)$; $Te(n,\gamma)$; $Te(n,2n)$; $Te(\gamma,n)$; $U(n, -)Sb^{129}(4 \cdot 2$ hr.$) \rightarrow Te^{129}$
Te^{127}	90 ± 2 days $\rightarrow 9 \cdot 3 \pm 0 \cdot 5$ hr. $\rightarrow I^{127}$	$Te(d,p)$; $Te(n,\gamma)$; $Te(n,2n)$; $I(n,p)$; $Sn(\alpha,n)$; $U(n, -)$ $Sb^{127}(80$ hr.$) \rightarrow Te^{127}$
Te^{121}	125 ± 5 days $\rightarrow Sb^{121}$	$Sb(d,2n)$; $Sb(p,n)$; $Sn(\alpha,n)$.

AUTHORS.

1505. Distribution in energy of fragments from U fission. M. H. KANNER AND H. H. BARSCHALL. *Phys. Rev.*, **57**, *pp.* 372–378, *March* 1, 1940.—The ionization produced by the fragments from U fission was measured. The number-energy curve shows two peaks corresponding to 65 and 98 eMV. The ionization produced by the two fragments simultaneously was measured by using a thin foil coated with U. The number-energy curve has one peak at 159 eMV and a half-width of 30 eMV.

AUTHORS.

1506. γ-Radiation from N bombarded with deuterons. E. R. GAERTTNER AND L. A. PARDUE. *Phys. Rev.*, **57**, *pp.* 386–389, *March* 1, 1940.—The energies and the relative intensities of the γ-rays emitted from N bombarded by deuterons of 700 ekV energy have been measured by the positron-electron pairs and recoil electrons ejected from thin laminae placed inside a cloud chamber. The distribution of pairs ejected from a Pb lamina 0·026 cm. thick reveals two strong components of quantum energy $7 \cdot 2 \pm 0 \cdot 4$ eMV and $5 \cdot 3 \pm 0 \cdot 4$ eMV, and a number of weaker components which may be attributed to radiation of about 4 and 2 eMV. There are also a number of pairs which extended up to 11 eMV. The distribution of recoil electrons from a C lamina 0·12 cm. thick indicates two strong groups of quantum energy 4·2 and 2·2 eMV. No attempt was made to extend the recoil measurements to higher energies. The 7·2 eMV radiation is attributed to the reaction $N^{14} + H^2 \rightarrow C^{12} + He^4$, because radiation of this energy has been observed in other reactions producing C^{12}. The 5·3-eMV radiation is attributed to an excited state of N^{15} of this energy according to the reaction $N^{14} + H^2 \rightarrow N^{15} + H^1$ in good agreement with the value of 5·4 eMV predicted by the range measurements of Cockcroft and Lewis. An attempt is made to correlate the energies and intensities of the γ-rays produced by excited states in C^{12}, N^{15} and O^{15} according to several reactions. AUTHORS.

1507. Yield of nuclear reactions with heavy elements. V. F. WEISSKOPF AND D. H. EWING. *Phys. Rev.*, **57**, *pp.* 472–485, *March* 15, 1940.—The cross-sections for different kinds of nuclear reactions are calculated as functions of the energy of the bombarding particles by means of statistical methods. Their application is restricted to heavy elements ($A > 50$) and to bombarding energies greater than 1 eMV. The excitation curves of several (p,n)-reactions have been measured for elements with A between 60 and 115 ; it is found that the measured cross-sections and their dependence on the energy suggests a nuclear radius of $R = 1 \cdot 3 \times 10^{-13} \times A^{\frac{1}{3}}$ cm. for these elements. Section I gives a complete discussion of the calculated cross-sections. Sections II and III contain the derivations of these expressions. Section IV describes the new experimental material and its implications for the theory. AUTHORS.

1508. Excitation of the 455-ekV level of Li^7 by proton bombardment. C. M. HUDSON, R. G. HERB AND G. J. PLAIN. *Phys. Rev.*, **57**, *pp.* 587–592, *April* 1, 1940.—The yield of γ-rays from a thin film of Li bombarded by protons has been investigated up to 2·08 eMV, by recording both single and coincidence counts in G-M tubes. Above 0·85 eMV proton energy most of the radiation is shown to be due to excitation of the 0·455-eMV level of Li^7 without permanent capture of the proton. The yield of 17-eMV radiation does not drop to zero above 0·440 eMV. It falls to a low value and remains approximately constant up to 1·6 eMV. The absorption coefficient in lead for the soft γ-radiation from Li was compared to the absorption coefficient of annihilation radiation from N^{13}. A value of 0·459 eMV was obtained for the energy of the soft Li radiation by assuming monochromatic radiation of 0·511 eMV from N^{13}. This close agreement with the expected energy indicates that not over 10% as many 0·28-eMV quanta as 0·511-eMV quanta are present in the radiation from N^{13}. AUTHORS.

1509. Radioactivity of ^{20}F. S. C. CURRAN AND J. E. STROTHERS. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 252–254, *April*, 1940.—The transition $^{20}F \rightarrow {}^{20}Ne$ is shown to occur with the emission of a β-particle of maximum energy $5 \cdot 0 \times 10^6$ eV, followed by a γ-quantum of energy $2 \cdot 2 \times 10^6$ eV. The transition from the excitation level of ^{20}Ne at $2 \cdot 2 \times 10^6$ eV sometimes occurs in two stages with the emission of two quanta of smaller energy. [See Abstract 119 (1940).] AUTHORS.

***1510. Application of method of coincidence counting in β-particle spectrograph of novel design.** N. FEATHER. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 224–235, *April*, 1940.—First-order calculations are given concerning the possibility of designing a β-particle spectrograph in which the correlation between the photo-electrons of the stronger " natural β-ray lines " and the disintegration particles of the " continuous spectrum " might be investigated. It has been shown that, with a coincidence counting circuit of resolving time 10^{-6} sec., and with a source of suitable strength, this investigation should be possible in the case of any natural β-ray line the absolute intensity of which is sensibly greater than 0·01. A successful investigation of this kind would provide important data for the analysis of a complex continuous spectrum into the " partial spectra " corresponding to different modes of transformation (and might furnish direct information regarding the internal absorption coefficients appropriate to the stronger γ-radiations involved). The construction of a β-particle spectrograph embodying the necessary features is described. AUTHOR.

1511. β-Ray spectrum of RaE. G. J. NEARY. *Roy. Soc., Proc. A*, **175**, *pp.* 71–87, *March* 28, 1940.—The β-ray spectrum of RaE has been investigated with a magnetic spectrograph of special design with a source on $\frac{1}{2}\mu$ aluminium and a counter window of 10^{-5} gm./cm^2. Zaponlak.

It is considered that the experimental results represent directly the distribution of particles from about 20 ekV upwards without distortion from any cause. The energy curve has a maximum at 150 ekV and an end-point at 1·17 MeV, with a mean energy of 340 ekV in complete agreement with calorimetric determinations. The momentum curve has a maximum at $H\rho = 1\,800$ G-cm. in satisfactory agreement with Flammersfeld, $H\rho = 1\,750$ G-cm. The intermediate part of the K.U. plot is straight, the energy difference between experimental and extrapolated end-points being $0{\cdot}55\, m_0C^2$; on the other hand, the introduction of a finite neutrino mass does not bring about agreement with theory. The K.U. plot also falls below the straight line below 150 ekV, and resembles some of the possible distributions for "forbidden" transitions, as given by Hoyle. AUTHOR.

1512. Secondary γ-rays from RaE. E. STAHEL AND J. GUILLISSEN. *J. de Physique et le Radium*, **1**, *pp.* 12–17, *Jan.*, 1940.—The internal secondary γ-rays from RaE have been studied experimentally with a high-pressure ionization chamber since RaE does not emit primary nuclear γ-radiation. The method depends on determining the absorption in Pb of the γ-rays from various substances surrounding the RaE source. The results have been compared with the theory of Knipp and Uhlenbeck. The agreement with theory, both in quality and quantity of the radiation, is good, provided the calculations are based on the experimental distribution of β-radiation. If Fermi's theory of β-decay is adopted, the agreement with theory is poor. This latter conclusion is in accord with the results of other workers on the β-decay of RaE. G. O. B.

***1513. Scale-of-three counter.** P. OHLIN. *Phil. Mag.*, **29**, *pp.* 285–288, *March*, 1940.—The instrument serves the purpose of registering rapid impulses generated in a Geiger-Müller counter. The circuit is formed by three identical branches, each consisting mainly of a thyratron and a pentode in series. The control grid of each pentode is biased by a voltage drop developed in the preceding branch. This arrangement allows full use to be made of the three stable conditions of a thyratron: "lighted", "blocked", and "extinguished, but ready to be lighted". These three phases also characterize each branch. Thus the possibility that one impulse may cause a thyratron to strike twice is excluded, an advantage as compared with the hitherto known scale-of-two counters. In addition, capacities in parallel to the bias resistors permit the thyratron action to be conveniently delayed, so as to prevent any two branches from counting the same impulse. The particular circuit described in the paper can count ca. 350 imp./sec. Used for X-ray intensity measurements the apparatus proved reliable. H. O. S.

See also Abstracts 1351, 1531, 1532, 1648 and
801B. Production of accelerating fields for investigations in atomic physics. R. Elsner and R. Strigel.

RADIATION.

ABSORPTION.

1514. Colour in relation to chemical constitution. S. DUTT AND B. M. S. AGARWAL. *Indian Acad. Sci., Proc. A*, **11**, *pp.* 96–103, *Feb.*, 1940.—Isonitroso-diphenylthio-hydantoin has a bright yellow colour in the solid state or in solution in organic solvents, but on treatment with alkalies or organic bases, intense crimson coloured salts are formed, the transition of colour from yellow to crimson being sufficiently strong and sharp for the compound to act as an excellent indicator. The change of colour of the above compound from yellow to crimson has been shown from theoretical considerations to be due to a fundamental change in the constitution of the molecules from an oximinoketonic to a nitroso-enolic form. The above change is in accordance with the molecular strain theory of colour. [See Abstract 2314 (1926).] AUTHORS.

1515. Estimate of extreme u.v. absorption of air. E. G. SCHNEIDER. *J.O.S.A.*, **30,** *pp.* 128–132, *March,* 1940.—Quantitative measurements on the absorption coefficient of air have been made for about three hundred and fifty points between 380 and 1 600 Å. Because of difficulties in maintaining a constant intensity with extreme u.v. light sources, it was necessary to use a many-line spark source rather than a continuous spectrum, with the result that much of the fine structure of the absorption bands has been lost. Photographic measurements with oiled plates show strong absorption between 1 600 Å and 1 300 Å, a quite transparent region between 1 300 Å and 1 000 Å, and a very highly absorbing group of bands at the shorter wave-lengths. Although these bands below 1 000 Å are poorly resolved, a wealth of fine structure is evident. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1516. Electric double refraction. A. DE STEFANO. *N. Cimento,* **16,** *pp.* 497–512, *Dec.,* 1939.—The paper is a résumé of the present day knowledge of the Kerr effect. The theories of the effect are discussed for gases, liquids and solids, and the calculated values for the Kerr constant are compared with the observed data in tables. L. K.

1517. Anisotropic absorption by dissolved molecules in electric fields. W. KUHN, H. DÜHRKOP AND H. MARTIN. *Zeits. f. phys. Chem. B,* **45,** 2, *pp.* 121–155, 1939.—The absorption of light by polar molecules orientated in an electric field will vary with their orientation relative to the field, and the orientation for maximum absorption may be different for different bands. Solutions of such molecules should therefore exhibit " electric dichroism ", a difference in absorption for vibrations parallel and perpendicular to the external field. The magnitude of this effect is calculated in terms of the dipole moment, the strength of the applied field and the degree of preference of a given wavelength for a given vibration direction. It is measured for solutions of *p*-nitrosodimethylaniline in hexane at three wavelengths. At 4 359 Å the dichroism is total, and the molecules only absorb vibrations perpendicular to the dipole axis. At 4 047 and 3 655 Å, the dichroism is weaker, and preferential absorption of vibrations parallel to the resultant moment is found. Since all three wavelengths fall inside the same absorption band, this must consist of at least two superposed systems. An attempt is made to predict the orientation of the molecules in crystals of *p*-nitrosodimethylaniline in the light of these results and of the observed crystal dichroism. C. B. A.

1518. Magneto-optical anomaly of H_2O and D_2O. A. OKAZAKI. *Phys. Math. Soc. Japan, Proc.,* **21,** *pp.* 753–758, *Dec.,* 1939.—Previous calculations of values of the magneto-optical anomaly of H_2O and D_2O at 20° for 5 893, 5 461, and 4 359 Å, based on their natural dispersions in the visible (6 563–4 358 Å) [see Abstract 2544 (1937)] have been extended to the u.v. at various temperatures. The γ-values, especially in H_2O, are nearly independent of the wavelength. Those for D_2O seem to decrease more or less systematically with decreasing wavelength and this is explained by the assumption that only the first term and the numerator in the third term of the dispersion formula for D_2O differ from those for H_2O. The γ-values for both H_2O and D_2O are almost independent of temperature up to 60°. At higher temperatures (76° and 92°) the value for H_2O is greater than normal. W. R. A.

1519. Optical and magnetic properties of a magnetite suspension. C. W. Heaps. *Phys. Rev.*, **57,** *pp.* 528–531, *March* 15, 1940.—A suspension of magnetite powder in oil acts in a limited way as a light shutter. When a magnetic field is parallel to the light direction more light is transmitted than when the light is transverse. Microscopic examination shows that the particles form elongated groups. Each particle is probably a single magnetic domain, magnetized to saturation, and hence it attracts neighbouring particles. The theory of the phenomenon, assuming the groups to be uniform and cylindrical, gives an equation for the amount of transmitted light in terms of magnetic field strength. This equation is subjected to experimental test and is not well verified. The magnetization curve of a dense suspension is determined experimentally and found to fit the Langevin curve fairly well. The group of particles, constituting the magnetic element, has an intensity of magnetization considerably less than the saturation value, although the individual particles are probably single, saturated domains. Author.

See also Abstract 1577.

EMISSION.

1520. Tables of Planck's radiation and photon functions. A. N. Lowan and G. Blanch. *J.O.S.A.*, **30,** *pp.* 70–81, *Feb.*, 1940.—Tables of $R_\lambda = c_1\lambda^{-5}/(e^{c_2/\lambda T} - 1)$ and of $N_\lambda = 2\pi c\lambda^{-4}/(e^{c_2/\lambda T} - 1)$ in the form of values of (i)$R_{0-\lambda}/R_{0-\infty}$, (ii) $R_\lambda/R_{\lambda(\max]}$, (iii) $N_{0-\lambda}/N_{0-\infty}$ and (iv) $N_\lambda/N_{\lambda[\max]}$ for values of λT from 0·050 to 2·00. Tables of R_λ and $R_{0-\lambda}$, N_λ and $N_{0-\lambda}$ for λ from 0·5 to 20μ when $T = 1\,000°$ K. Tables of N_λ for λ from 0·25 to 10μ for values of T from 1 000° to 3 500° and 6 000° K. An interpolation table is also included. The paper includes a Bibliography of tables relevant to the subject. J. W. T. W.

***1521. Evaluation of radiation intensities by a simplified spectrographic method.** A. J. Maddock. *Journ. Sci. Instruments*, **17,** *pp.* 89–92, *April*, 1940.—A method of comparing intensities of sources of radiant energy is described which is useful where rapid comparison at all wavelengths is required with relatively little apparatus, the method giving results usually within 10% of the true values and for the strongest lines better than 5%. It is further shown how the method may be extended to obtain the relative intensity distribution throughout the spectrum of a single source with the same degree of accuracy. The method employed is a photographic one and only utilizes a quartz spectrograph. Author.

1522. Secondary radiation of cosmic rays. G. Cocconi and V. Tongiorgi. *N. Cimento*, **16,** *pp.* 447–455, *Nov.*, 1939.—Using 3 counters arranged one above the other, examination is made of the angular aperture of cosmic-ray showers. The very soft and moderately soft components were scattered and absorbed according to accepted theoretical ideas. The hard component, however, contrary to Bhabha's theory, appears to produce rather more secondaries as the atomic number is reduced. F. C. C.

1523. New proof for instability of meson. G. Cocconi. *Ricerca Scientifica*, **11**, *pp*. 58–65, *Jan.–Feb.*, 1940.—Absorption measurements of cosmic rays in Pb reveal a pronounced deficiency at the low-energy side of the meson spectrum for rays incident at large angles. This effect furnishes a new proof for the instability of the meson which is independent of any assumptions on the relative stopping power of different substances, or substances in different states of condensation. Assuming $\tau = 2 \times 10^{-6}$ sec., the agreement between theory and experiment is satisfactory. The effect exists for rays of vertical incidence as well, although masked by the absorption of the soft component. This could account for the failure of Montgomery and co-workers to find decay-electrons from a 2-cm. Pb-plate under 12 cm. Pb [see Abstract 4301 (1939)]. L. E. F.

1524. 12-hr. period of mesotron intensity and altitude at which mesotrons are created. A. Ehmert. *Naturwiss.*, **28**, *pp*. 28–29, *Jan*. 12, 1940. —It is suggested that the variation of the mesotron intensity with a 12-hr. period is due partly to the pulsation of the atmosphere and partly to a variation of the horizontal component of the earth's magnetic field. The former is effective only because the mesotron is unstable. From a consideration of the phases of the pulsation and mesotron intensity it is pointed out that the mesotrons must be created at an altitude greater than 30 km., and, in fact, that from certain calculations 85% of the mesotrons have decayed before they get within 40 km. of the earth's surface. This has the effect of reducing the latitude effect for mesotrons and intensifying it for electrons, into which, it is assumed, the mesotrons decay. W. E. D.

1525. Variation of hard component of cosmic rays with height and disintegration of mesotrons. B. Rossi, N. Hilberry and J. B. Hoag. *Phys. Rev.*, **57**, *pp*. 461–469, *March* 15, 1940.—The vertical intensity of the hard component of cosmic rays was measured at different altitudes with a threefold coincidence counter tube arrangement. Measurements were taken with and without a graphite layer above the counters in order to compare the absorption of the hard component in air and in carbon. The counting rate observed under a given mass of air-plus-carbon was found to be considerably larger than the rate observed under the same mass of air alone. The authors interpret the difference as due to the spontaneous decay of the mesotrons which form the hard component of cosmic rays. Authors.

1526. Electrons arising from disintegration of cosmic-ray mesotrons. B. Rossi. *Phys. Rev.*, **57**, *pp*. 469–471, *March* 15, 1940.—A simple theoretical expression is deduced for the ionization produced by the electrons arising from the disintegration of cosmic-ray mesotrons. Author.

1527. Radiation producing cosmic-ray showers. V. H. Regener. *Ricerca Scientifica*, **11**, *pp*. 66–70, *Jan.–Feb.*, 1940.—The proportion of showers produced in Pb-plates of varying thickness (up to 8 cm.) by ionizing and by non-ionizing primaries is investigated by means of a coincidence-anticoincidence set which automatically excludes showers originating outside the Pb. At 1·5 cm. Pb approximately 34% of the showers are due to non-ionizing primaries; at 8 cm. Pb this proportion has fallen to $\sim$ 20%, but it remains constant within the experimental error at $\sim$ 35% if the contribution of the penetrating meson-showers—estimated by means of a theoretical formula due to Ehmert [see Abstract 3639 (1939)]—is deducted from the intensity of the showers with ionizing primaries. L. E. F.

1528. Theory of cosmic-ray showers. Part I. Furry model and fluctuation problem. A. Nordsieck, W. E. Lamb, Jr. and G. E. Uhlenbeck. *Physica*, **7**, *pp*. 344–360, *April*, 1940. *In English*.—The main problems regarding the shower formation by fast electrons are reviewed on the basis of a simplified model first proposed by Furry [see Abstract 5089 (1937)]. A general method is developed for calculating the fluctuation in the number of particles after a thickness x of matter. It is shown that $\overline{N^2(x)}$ can always be found when the average energy distribution F(E, x) is known. Using the approximate " cut-off " method the numerical values of $\overline{N^2} - (\overline{N})^2$ have been computed for the Furry model. The approach to the normal value of the fluctuation (corresponding to the Poisson distribution) is much slower than has been expected. Authors.

1529. Photon component of cosmic radiation and its absorption coefficient. L. Jánossy and B. Rossi. *Roy. Soc., Proc. A*, **175,** *pp*. 88–100, *March* 28, 1940.—Photons unlike ionizing particles cannot be observed directly with counters. Owing to this difficulty very few investigations dealing with the photon component of cosmic radiation have been carried out. In the present paper a simple method is described which is suitable for the observations of cosmic-ray photons. The transition effect of photon-initiated showers in lead has been measured. The result is in agreement with the prediction of the cascade theory of Bhabha and Heitler as extended by Arley. The absorption coefficients of cosmic-ray photons have been measured in Pb, Fe and Al, and they agree with the theoretical values as given by Bethe and Heitler. The lower limit for the total flux of cosmic-ray photons above 10^7 eV has been found to be 10% of the ionizing component of the cosmic-ray beam. Authors.

V.4
194

1530. Positive excess and electron component in the cosmic-ray spectrum. D. J. Hughes. *Phys. Rev.*, **57**, *pp*. 592–597, *April* 1, 1940.—The sea-level cosmic-ray energy spectrum has been determined, using a 30-cm. counter-controlled cloud chamber in a 12 400-oersted magnetic field. The spectrum of mesotrons alone is obtained by inserting a 10-cm. lead filter in the counter train, the total spectrum is obtained with no filtering, and the spectrum of the soft (electron) component is then the difference between these two spectra. An excess of positive particles exists both with and without the lead, the ratio of positives to negatives being 1·21 ± 0·08 (standard error) in the former, and 1·18 ± 0·08 in the latter case. Comparison of the spectra with and without lead shows the presence of an absorbable component (electrons) in the energy region 2 to 8×18^8 eV but no absorbable particles of higher energy. The spectra have been corrected for the distortion at low energies caused by the magnetic field. The corrected mesotron spectrum possesses a maximum and a rapid decrease below the maximum while the total spectrum shows no maximum but a continuous increase in number with decreasing energy. Author.

***1531. Report on the work of the Bartol Research Foundation, 1938–1939.** W. F. G. Swann. *Frank Inst., J.*, **229,** *pp*. 281–335, *March*, 1940.

***1532. Magnet and cloud chamber for cosmic-ray studies.** H. Jones and D. Hughes. *Rev. Sci. Instruments*, **11,** *pp*. 79–83, *March*, 1940.—Details are given of the construction of an electromagnet, cloud chamber and accessory apparatus for use in cosmic-ray studies. The magnet has 9 100 kg. of steel, 1 000 kg. of copper, and has pole faces 30·5 cm. dia., normally used at an air-gap of 19·2 cm. The magnet is oil-cooled and is usually operated at from 35 to 125 kW, the power being supplied by a motor-generator with variable field. Under these conditions the field increases from about 12 400 oersteds at the lower power to 16 000 oersteds at the higher power. The cloud chamber is of the diaphragm type, 30 cm. dia. by 4·2 cm. deep, and is filled with argon and ethyl alcohol vapour to 88 cm. Hg pressure. The photographs are taken with the help of a 45° mirror placed against the front glass of the chamber. For illumination a Sperry carbon arc or a capillary Hg arc is used, the latter proving on the whole more satisfactory. With the lower magnetizing currents the temperature of the magnet and chamber can be maintained so close to that of the outside air that convection currents are small, and the tracks show little distortion. Errors in measuring the energy of cosmic-ray tracks are caused chiefly by distortions of the tracks. The probable error is 6% for a track of 10^9 eV, and about equal to the energy itself when this is $1 \cdot 6 \times 10^{10}$ eV. AUTHORS.

See also Abstracts 1453, 1475, 1626.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTER-GLOW.

1533. Fluorescence of heavy metal complexes in aqueous solutions. P. PRINGSHEIM AND H. VOGELS. *Physica*, **7,** *pp.* 225–240, *March*, 1940. *In German.*—Under short-wave u.v. excitation Tl salts show in aqueous solution a violet fluorescence, attributed to the Tl^+ ion. In the presence of excess Cl^- or Br^- ions the fluorescence becomes an intense blue or green-blue and is then attributable to the Tl halogen complex ions. This is accompanied by a much weaker u.v. band. The halogen complexes with Pb and Sn show a bright green fluorescence. The nature of the emitter is discussed and for the case of the Tl complex measurements are given of the brightness and relative efficiency against Tl and Cl concentrations. The fluorescence of the Sn complex is rapidly quenched by the action of the exciting light. J. E.

1534. Luminescent materials. Part I. Theory of ZnS crystal phosphors. Y. UEHARA. *Chem. Soc., Japan, Bull.*, **14,** *pp.* 539–546, *Dec.*, 1939.—It is considered that an electron moving in the field of the crystal can have energies determined by the electronic energy of an isolated atom or ion together with the potential energy due to the neighbouring atoms or ions, and a term given by an exchange integral representing the broadening of levels due to molecular and lattice vibrations. The levels in ZnS·Cu given by the first two terms are worked out and shown in a diagram, assuming that the energy of electron affinity in an ion in a crystal is approximately equal to that in a free ion and that the potential energy due to neighbouring ions is the Madelung potential (i.e. neglecting the polarization effect in both terms). From a comparison of the excitation bands observed by Tomaschek and fluorescence observed by the author, excitation and fluorescence are associated with the Cu^+ ion. J. E.

See also Abstract

740B. New type of luminescent screen for cathode-ray tubes especially for television. A. de Quervain.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1535. Critical opalescence of binary and ternary liquid mixtures. P. MONDAIN-MONVAL AND J. QUIQUEREZ. *Comptes Rendus*, **210,** *pp.* 246–248, *Feb.* 12, 1940.—Binary or ternary liquid mixtures frequently show, when still in the zone of homogeneity but close to the mutual solubility curve, and more particularly when close to the critical solution temperature (c.s.t.) the phenomenon of critical opalescence: the mixtures, transparent to transmitted light, show a greenish or bluish opalescence by reflected light. The scattered light is polarized as for colloidal solutions. Experimental investigation by the authors shows that the occurrence of the phenomenon depends on the difference Δn in the refractive indices of the constitutent liquids. If $\Delta n < 0\cdot03$, opalescence is absent (e.g. $H_2O - C_2H_5OH - n$-pentane, $\Delta n = 0\cdot0304$). As Δn gradually increases from *ca.* 0·04 the opalescence begins to appear, first of all in the neighbourhood of the c.s.t., growing in intensity and occurring over a continually widening zone within the mutual solubility area. The effect is not due to any specific constitutent or chemical grouping. It is suggested that the phenomenon is physical in origin, the mixtures being best regarded as colloidal emulsions in which the dispersed particles are indefinitely small. S. J. G.

See also Abstracts 1490, 1623.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1536. Quantum yield in hydrolysis of monochloro-acetic acid. L. Küchler and H. Pick. *Zeits. f. phys. Chem. B*, **45**, 2, *pp.* 116–120, 1939.—The quantum yield during the u.v. hydrolysis of monochloro-acetic acid has been re-determined as an actinometer reaction, and for $\lambda = 254$ mμ, the value $\phi = 0\cdot62 \pm 0\cdot04$ has been found compared with the Rudberg value $\phi = 1\cdot0$. The measurements were carried out by Rudberg's method and experimental details are included in the paper. It was found that: (1) the Cl-ion formed could be readily determined by potentiometric titration; (2) the quantum yield was independent of the concentration and spatial energy density of the radiation; (3) the thermal hydrolysis at great intensities could be completely ignored below 50°C. and was easy to account for at small intensities; (4) photochemical activity occurred with light of wavelengths smaller than 270 mμ. The quantum yields of other photochemical reactions which depend on the data for monochloro-acetic acid are corrected for the new value of ϕ. H. H. Ho.

1537. Photo-polymerization of anthracene in benzene solution. S. S. Bhatnagar, P. L. Kapur and G. Kaur. *Indian Acad. Sci., Proc., Sect. A*, **10**, *pp.* 468–476, *Dec.*, 1939.—When cyclopentadiene is polymerized to dicyclo-pentadiene, the susceptibility drops, and a similar phenomenon occurs in thiophosgene. This polymerization involves a change from carbon double bonds to single bonds, and should consequently give rise to an increase in susceptibility. If, however, a bridged ring were formed, the decrease could be explained. When anthracene is photopolymerized to dianthracene, a bridged four-membrane ring is formed. The susceptibility of dianthracene is therefore studied to throw light on the other compounds. Anthracene was polymerized by light, in air, and various oxidation products were formed as well as dianthracene, thus complicating the results. The process was repeated in the absence of air. A large fall in the diamagnetism was observed on polymerizing anthracene. It is explained by assuming that the polymerization is accompanied by a decrease in the radius of the molecule formed. A. C. M.

1538. Quenching of mercury resonance radiation by ethylene. E. W. R. Steacie. *Canad. J. of Research, B*, **18**, *pp.* 44–46, *Feb.*, 1940.—An investigation has been made of the quenching of Hg resonance radiation

V.4
194

(λ2 537) by ethylene. A quenching cross-section of $48 \pm 5 \times 10^{-16}$ cm². was found. [See Abstract 4603 (1935).] AUTHOR.

1539. Cadmium photosensitized reactions of ethylene. E. W. R. STEACIE AND R. POTVIN. *Canad. J. of Research, B,* **18,** *pp.* 47–54, *Feb.*, 1940.—An investigation has been made of the Cd-photosensitized reactions of C_2H_4 and $(C_2H_4 + H_2)$ mixtures. With C_2H_4 alone the quantum yield of the reaction is very low, viz. about 0·01. With $C_2H_4 + H_2$ mixtures the quantum yield is about 0·5 to 0·7 depending upon the conditions. The products of the reaction are methane, ethane, propane, butane, propylene, and higher hydrocarbons. The mechanism of the reaction is discussed and compared with that of the Hg-photosensitized reaction. It is concluded that the main steps of the reaction in the presence of H_2 are $H + C_2H_4 \rightarrow C_2H_5$; $H + C_2H_5 \rightarrow C_2H_5$; $H + C_2H_5 \rightarrow 2CH_3$, together with radical recombination reactions, and reactions of the type $C_2H_4 + C_2H_5 \rightarrow C_4H_9$. [See Abstract 244 (1939).] AUTHORS.

1540. Relative efficiency of active u.v. wavelengths in activation of 7-dehydrocholesterol. J. W. M. BUNKER, R. S. HARRIS AND L. M. MOSHER. *Am. Chem. Soc., J.,* **62,** *pp.* 508–511, *March*, 1940.—The photochemical activation of crystalline 7-dehydrocholesterol in ether by monochromatic u.v. rays of 2 483, 2 537, 2 652, 2 804 and 3 025 Å is substantially uniform per quantum of energy applied. On a quantum basis, the activation by 2 967 Å is significantly greater than for any other wavelength examined, with the possible exception of 2 894 Å. The activation by 2 894 Å appears to be intermediate between that of 2 967 Å and the other wavelengths tested. No demonstrable antirachitic properties were produced by irradiation of 7-dehydrocholesterol in ether by u.v. rays of 3 130 Å. The superior effectiveness of 2 967 Å in antirachitic activation of 7-dehydrocholesterol parallels the significant superiority of this wavelength in inducing healing upon direct irradiation of depilated rachitic rats, which supports the hypothesis that 7-dehydrocholesterol is a significant precursor of vitamin D in the skin. AUTHORS.

1541. Reaction of atomic hydrogen with hydrazine. E. A. B. BIRSE AND H. W. MELVILLE. *Roy. Soc., Proc. A,* **175,** *pp.* 164–186, *April* 10, 1940. —The efficiency of the reaction of atomic H with N_2H_4 has been measured in the temperature range 20–200°C. by comparison with that of the H atom-sensitized conversion of para-H_2. A static system is employed, the H atoms being produced by excited Hg atoms. The energy of activation is nearly the same as that of the para-H_2 conversion, namely *ca.* 7 kg.cal., and the steric factor is *ca.* 10^{-2}. From these results it is shown that hydrazine is not responsible for the low stationary H-atom concentration in the photolysis of NH_3 as has hitherto been supposed. Although the H atoms react very efficiently with N_2H_4 the quantum efficiency of this reaction is only 0·4 instead of the expected value of 2. An explanation of this result is suggested. It is also shown that photodecomposing N_2H_4 converts para-H_2. This is taken to mean that the primary decomposition is represented by $N_2H_4 + h\nu = N_2H_3 + H$. The quantum efficiency of the Hg-sensitized decomposition of N_2H_4 has been found to be 0·37. An explanation of this unexpectedly low value is given. A new simplified method of analysing the ternary mixture $p\text{-}H_2 - n\text{-}H_2 - N_2$ is described. [See following Abstract.] AUTHORS.

1542. Photolysis of ammonia. E. A. B. BIRSE AND H. W. MELVILLE. *Roy. Soc., Proc. A,* **175,** *pp.* 187–207, *April* 10, 1940.—The anomalously low stationary H-atom concentration during the photodecomposition of NH_3

is due either to the fact that the primary photochemical efficiency is not unity or that the H atoms are removed at an abnormally fast rate. It is shown by utilizing the para-H_2 conversion that photodecomposing NH_3 has no effect on the stationary H-atom concentration of the conversion, and therefore the low concentration of the NH_3 photolysis must be due to inefficiency of the primary process. The primary efficiency is determined by a careful comparison of the Hg-sensitized and the NH_3-sensitized conversion of para-H_2. A method is developed for measuring accurately the rate of production of H atoms, which method is essential to the foregoing determination. This primary efficiency is found to be 0·58. A method is also developed for measuring the lifetime of amine radicals. Similar experiments with ND_3 are also described. The primary efficiency is 0·28. A revised and simplified scheme for the NH_3 photolysis is given as a result of these new experiments. [See preceding Abstract.] AUTHORS.

1543. Lack of definition of negative due to regular motion of object. M. NAGEL. *Zeits. f. wiss. Phot.*, **38,** *pp.* 181–209, *Sept.–Oct.*, 1939.—Discusses the lack of definition (l.d.) in photographs of rapidly moving objects, e.g. as in aerial photography, and points out that the errors consequent thereon are due not only to physiological errors in judging the sharpness, but also to objective causes. The present report deals with the latter. The l.d. depends not only on the distance traversed by the photographic image during exposure, but also on the sensitivity of the emulsion, the distribution of light in the object photographed and its surroundings, the variation of brightness in the intervening time-space and also on the geometrical dimensions of the object. The l.d. is calculated as a function of known magnitudes and rules are deduced which can be used to attain either (i) the sharpest possible pictures or (ii) an accurate estimation of the distance moved by the image during exposure. The rules have been tested experimentally and found satisfactory. S. J. G.

1544. Increase in sensitivity in reversal development. H. STAUDE. *Zeits. f. wiss. Phot.*, **38,** *pp.* 209–212, *Sept.–Oct.*, 1939.—The increase in sensitivity in reversal development is not due to the solvent action of the fixing bath on the separated Ag; it is explained rather by the action of the AgBr solvent in removing outer layers of AgBr thus laying bare the nuclei in the interior. The probability that for very small illuminations a development centre will be formed in the interior is much greater than that it will be formed on the surface, corresponding to the ratio of AgBr nuclei in the interior to those on the surface. Now for normal development, nuclei in the interior of a grain are not immediately accessible (i.e., are not developed), and, although for longer immersion development occurs, these later developed grains do not contribute to the image, being "drowned" at these places in haze. For a developer containing AgBr solvent the outer layers are dissolved and the nuclei in the interior laid bare; the grains can then undergo immediate development. S. J. G.

1545. Sensitometric study of developers and emulsions of astrophysical interest. D. R. BARBER. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 180–188, *Jan.*, 1940.—An investigation is described in which the influence of 3 different developers upon 9 dissimilar emulsions is examined from an astrophysical standpoint. Values of background (chemical) fog, contrast factor and effective sensitivity, at different density levels, have been derived from microphotometer measures of plates exposed in a tube sensitometer. The influence of the developing agent upon the quantities enumerated is discussed for the various emulsions tested. A series of diagrams is reproduced to illustrate graphically the change in the effective response of the emulsion at different densities, expressed as a magnitude gain, or loss, referred to standard development. Comparisons are made of the graininess of the developed image for each of the emulsion-developer combinations. These have been derived from microphotometer tracings at a constant density level of 0·5. It is concluded that the standard metol-hydroquinone developer is the most suitable for use in astronomical photography. It is capable of yielding negatives of excellent quality when used in combination with a wide range of emulsion types. AUTHOR.

***1546. Intensity-scale monochromatic sensitometer.** C. H. EVANS. *Kodak Research Lab., Comm. No.* 750. *J.O.S.A.*, **30,** *pp.* 118–127, *March*, 1940.—A working model of a monochromatic sensitometer covering the wavelength region from 3 500 to 11 000 Å has been built. Monochromatic radiation used for exposure is obtained from a double monochromator employing transmission replica gratings as the dispersing elements. The intensity of this radiation is measured with a thermopile. Intensity-scale exposures upon the photographic material result from the use of a specially designed intermittent intensity-scale sector wheel. The same time of exposure is employed at all wavelengths, and therefore the spectral sensitivity curve derived from the intensity-scale characteristic curves is independent of any reciprocity-law failure which the emulsion may exhibit. AUTHOR.

***1547. Device for plotting characteristic curves.** D. R. BARBER. *Journ. Sci. Instruments*, **17,** *pp.* 95–97, *April*, 1940.—A mechanical device for plotting characteristic (H and D) curves of photographic emulsions is described. Details of construction are given, and readings from the instrument are compared with those obtained from an orthodox plot on graph paper. Considerable saving of time, and of material, may be effected by its use in instances where values of co-ordinates are to be entered from curves of similar character drawn through a series of experimental points, for which one set of co-ordinates has fixed values. AUTHOR.

1548. Latent photographic image: Additivity of part-exposures and microscrystalline state of silver halide grains. J. C. M. BRENTANO AND S. BAXTER. *Faraday Soc., Trans.*, **36,** *pp.* 581–597, *April*, 1940.—Experiments on the formation of the latent photographic image, in particular the threshold and a regression or deficiency observed in the addition of part-exposures, are described. The dependence of this regression depends on density, on the length and number of interruptions, and the manner in which it is affected by cooling and by flooding with infra-red are examined. Subsidiary experiments comprise a statistical discussion of the threshold, an X-ray examination of the micro-crystalline state of the grains of photographic emulsions and experiments on the superposition of radiations with different wavelengths. The results are discussed with regard to possible interpretations derived from a wave-mechanical model. AUTHORS.

***1549. Treatment of camera lenses with low-reflecting films.** C. H. CARTWRIGHT. *J.O.S.A.*, **30,** *pp.* 110–114, *March*, 1940.—An *f* : 2 photographic lens having five separated elements was treated with evaporated fluorite to decrease the reflection from all ten air-glass surfaces. Photographs were taken with the lens under carefully controlled conditions before and after it was treated. The effective speed of the lens was found to be almost doubled by the treatment. A slight increase in contrast resulted in photographs taken under normal lighting conditions and a large increase in contrast resulted in those taken under adverse lighting conditions. An increase in detail was observed, because of the absence of flare, and the ghost images usually observed under adverse lighting conditions were eliminated. AUTHOR.

See also Abstract 1678.

PHOTOMETRY.

See Abstract 1468 and

836B. The luximeter. W. L. Carson.
839B. Precision flicker-photometer. G. Timoshenko and W. J. Glasson.

POLARIZATION.

1550. Asymmetric solvent action. T. S. PATTERSON AND C. BUCHANAN. *Chem. Soc., J., pp.* 290–293, *March,* 1940.—Previous work [see Abstract 4020 (1937)] has been repeated and extended, from which it appears (1) that data formerly obtained with nitrobenzene as a solvent for *iso*butyl *d*- and *l*-tartrates were faulty ; (2) that benzyl benzoate is more suitable as a solvent for this purpose than is nitrobenzene ; (3) that the M.S.V. of *iso*butyl *d*-tartrate is definitely, although only slightly, *greater* than that of *iso*butyl *l*-tartrate in *l*-menthyl acetate, whereas they are equal within the limit of experimental error in benzyl benzoate ; (4) the M.S.V. of ethyl diacetyl-*d*-tartrate is definitely *less* than that of ethyl diacetyl-*l*-tartrate in menthyl acetate, whereas they are equal within the limit of experimental error in benzyl benzoate. It is therefore claimed that asymmetry of solvent action has now been established. The fact that the volume-difference for the first pair of enantiomorphs is in the opposite sense from the volume-difference for the second pair helps considerably to justify this conclusion. AUTHORS.

1551. Solvent effects with optically active saturated hydrocarbons. A. W. H. PRYDE AND H. G. RULE. *Chem. Soc., J., pp.* 345–347, *March,* 1940.—The theoretical relationship assumed to exist between the optical activity of a compound and the refractive index of its solution is further tested in the cases of the saturated hydrocarbons *l*-dimenthyl, *l*-dibornyl, and *d*- and *l*-*iso*camphanes, when dissolved in non-polar diluents. In no case was the magnitude of the rotation found to be simply related to the refractive properties. The approximate relationship previously reported for *d*-pinane in non-polar solvents has been confirmed. [See Abstract 1179 (1937).] AUTHORS.

***1552. New polarimetric arrangement.** E. PERUCCA. *Accad. Sci. Torino, Atti,* **75,** *Disp.* 1a, *pp.* 172–176, *Nov.–Dec.,* 1939. *N. Cimento,* **17,** *pp.* 1–4, *Jan.,* 1940.—A penumbral analyser is described, which is of low cost and high accuracy. It can be used with any light source, provided this is monochromatic. With a source which is practically point-form, the apparatus is capable of an accuracy as great as that of the classical apparatus of Lippich. The theory of the apparatus is briefly discussed. S. J. G.

See also Abstract 1555.

REFLECTION, REFRACTION AND DISPERSION.

1553. Table of Fresnel reflection. P. MOON. *J. Math. Phys.,* **19,** *pp.* 1–33, *Jan.,* 1940.—The table gives the reflection factor, computed by Fresnel's formula for a plane dielectric interface, for the following values of the variables ; angle of incidence, 0 to $\pi/2$ by steps of 0·02 radian ; relative refractive index, 1·1, 1·2, 1·3, 4/3, 1·4, 1·5, 1·6, 1·7, 1·8, 1·9 ;

electric vector in or perpendicular to the plane of incidence. The values are given to 8 significant figures. W. S. S.

***1554. Production of non-spherical optical surfaces.** A. Couder. *Comptes Rendus*, **210,** *pp.* 327–329, *Feb.* 26, 1940.—The author discusses the figuring of non-spherical surfaces for Schmidt plates used for correcting by refraction the spherical aberration of an astronomical mirror. The surface is obtained by spherically grinding the glass plate whilst it is subject to a constraint whose subsequent removal allows the plate to take up the required form. The constraint is applied by partially evacuating a cylindrical vessel to which the plate forms a lid. Expressions are obtained which give the radius of the grinding tool and the pressure difference in terms of the dimensions and optical and mechanical properties of the glass. Limiting thicknesses are given for the plate corresponding respectively to the maximum pressure available and to the requirements of safety during grinding. A. Hu.

1555. Optical anisotropy of molecular crystals. I. Nitta. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 957, *pp.* 114–130, *Feb.*, 1940. —For a case of the body-centred tetragonal lattice, it is shown that the double refraction D of a molecular crystal can be resolved into two terms D_M and D_S, the former depending on the optical anisotropy of the molecule (molecular double refraction) and the latter on the parameters of the crystal structure (structural double refraction). As illustrations, the principal polarizabilities for the molecules of pentaerythritol, pentaerythritol tetranitrate and pentaerythritol tetraacetate were calculated from the optical and the X-ray data of these crystals. The values obtained stand in conformity with their molecular structure. For pentaerythritol crystal the temperature coefficient of the double refraction was also calculated. This agrees well with the observed value. Finally, the validity of the Lorentz-Lorenz relation applied to birefringent crystals and the implication of the molecular refraction for a liquid are briefly discussed. Author.

1556. Glasses, organic and inorganic. H. Moore. *Soc. Glass Technol., J.*, **23,** *pp.* 347–371, *Dec.*, 1939.—This review of the present position of glass technology commences with a history of the subject, following which the nature and structure of glasses is dealt with in detail. First comes a brief survey of the structure of inorganic glasses, which, however, is limited to single- and two-component glasses, and it is shown that their structures are based on a type of non-repeating network rather than on a crystallite texture. Recent X-ray studies by Warren [see Abstract 5183 (1937)] have indicated that liquids have a non-periodic structure similar to that ascribed to glass but characterized by continuous change, which supports the view that glass can be regarded most satisfactorily as a liquid. Thermoplastic organic glasses are next considered and their thread-like molecular nature emphasized, following which the insoluble polymeric glasses are shown to possess structures which may vary from chains linked together by occasional bridges to a highly complex network in which the number of linkages between the chains is very large. Organic glasses from thermo-hardened resins are shown to be characterized by their 3-dimensional irregular network structure, and the 3 main types to be considered as glass substitutes are described, viz., phenol-formaldehyde, urea-formaldehyde, and the alkyl resins. The final section is devoted to the physical properties of organic and inorganic glasses and includes a very comprehensive table of data. H. H. Ho.

***1557. Microscope objectives with internal reflector.** C. SPIERER. *Arch. des Sciences*, **22,** *pp.* 5–31, *Jan.–Feb.*, 1940.—A method of obtaining oblique illumination in an immersion objective by means of a metallic reflecting area situated excentrically on the upper surface of the frontal lens is described. The arrangement preserves the dark ground necessary for sharp contrast, and also the resolution. A number of examples of its use in interesting biological and chemical problems are reproduced. C. B. A.

See also Abstracts 1429, 1549, 1551, 1602, 1617, 1675.

SPECTROSCOPY.

1558. Doppler effect in resonance lines. L. G. HENYEY. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 50–54, *Jan.*, 1940.—The Doppler broadening of a resonance line in absorption depends both on the variation of absorption coefficient with position in the line and on the distribution of scattered light over the line. Since the Doppler effect is not in general the same along the direction of the scattered ray as it is along the primary ray, an independent derivation of the distribution of the scattered light is necessary and is carried out in this paper. It is shown that the scattered light has a maximum at a frequency which, as the angle of scattering increases from 0 to π, moves progressively from the primary frequency to a frequency equally displaced on the other side of the core of the line. If the primary frequency is well outside the core of the line, however, the situation is different. W. S. S.

1559. Infra-red absorption spectrum of methylamine. R. G. OWENS AND E. F. BARKER. *J. Chem. Phys.*, **8,** *pp.* 229–232, *March*, 1940.—The parallel type methylamine band at 10μ has been resolved. Its centre is at $1\,045 \cdot 27$ cm^{-1}., and the very regular structure of its P and R branches indicates a close approximation to axial symmetry. The mean of the two largest moments of inertia is $37 \cdot 43 \times 10^{-40}$ gm·cm^2. Assuming angles and distances for NH_2 as in ammonia, and for CH_3 as in methane, the C–N distance is computed to be $1 \cdot 48 \times 10^{-8}$ cm. Certain enhanced lines suggest a superposed perpendicular band. The 13μ band is partially resolved, and assigned to a motion corresponding to ν_3 in NH_3. The bands arising from vibrations characteristic of the amino and methyl groups have been examined but could not be resolved. AUTHORS.

1560. Vibration spectra and molecular structure. Part IX. Vapours of fatty acid series. R. C. HERMAN. *J. Chem. Phys.*, **8,** *pp.* 252–258, *March*, 1940.—The monomer spectra of the vapours of C_3H_7COOH, C_3H_7COOD and C_4H_9COOH have been obtained in the near infra-red with a rock-salt spectrometer. The association of each of the following molecules: HCOOH, HCOOD and C_3H_7COOD has been studied in the vapour phase by measuring the variation with temperature and pressure of the intensity of some association band. The bond strengths obtained for these fatty acids are $6 \cdot 2$, $6 \cdot 4$ and $6 \cdot 9$ kg.cal./mol. per bond, respectively. The fact that the bond strengths for light and heavy formic acids agree within the experimental error although the determinations were carried out with different bands is further evidence that the spectroscopic method is satisfactory. The lower value obtained for the bond strength in formic acid by this method compared to the vapour density value is discussed. In addition, it is suggested from the experimental data available at the present time, that it does not seem possible to claim the existence of a simple linear relationship between the bond strength and $\Delta\nu/\nu$. Some results concerning ν(CH) absorption in the first 5 members of the fatty acid series are given. [For Part VIII see Abstract **4044** (1939).] AUTHOR.

1561. Mass ratio of Li isotopes from red bands of Li_2. A. MCKELLAR AND F. A. JENKINS. *Dominion Astrophys. Obs., Victoria, Publ.*, **7**, 9, *pp.* 155–187, 1939.—The red $^1\Sigma$, $^1\Sigma$ absorption bands of Li_2 have been photographed with a dispersion of 0·8 Å/mm. Measurements upon 11 bands due to the Li^7 Li^7 and 10 bands of the Li^6 Li^7 molecule are listed and have been used to derive the molecular band constants of the two molecules, hence to evaluate the mass coefficient ρ and the mass ratio Li^7/Li^6. Band lines up to $K'' = 30$ were utilized and three methods of reducing the data were employed, that previously used by the writers on the BO and blue-green Li_2 bands and those used by Almy and Irwin on the red Li_2 bands. The three methods are shown to yield very consistent results, giving a mean value of $\rho = 1{\cdot}040\,76 \pm 0{\cdot}000\,03$, corresponding to a mass ratio $Li^7/Li^6 = 1{\cdot}166\,36 \pm 0{\cdot}000\,09$. This result is shown to be unaffected by the small corrections to the simple isotope theory and to be in excellent agreement both with Almy and Irwin's value of $1{\cdot}166\,40 \pm 0{\cdot}000\,12$ and the ratios obtained from mass determinations by the mass spectrograph and from nuclear transformation data, most recent of which give $1{\cdot}166\,42 \pm 0{\cdot}000\,05$. A small electronic isotope shift was found, amounting to $\nu_e{}^i - \nu_e = -0{\cdot}054 \pm 0{\cdot}009$ cm^{-1}., which agrees well with that of $-0{\cdot}064 \pm 0{\cdot}010$ cm^{-1}. determined by Almy and Irwin. This shift is shown not to disagree in magnitude and direction with that possibly expected on the basis of recent calculations by van Vleck on the H_2 spectrum; these calculations can be carried out partially but not completely in the present case.
AUTHORS.

1562. (0,0) Band of OD. M. ISHAQ. *Nat. Inst. Sci., India, Proc.*, **5**, 3, *pp.* 309–311, 1939.—The tail end of the OD spectrum taken in the 4th order of a 10-ft. concave grating has been measured and the (0,0) band extended considerably. The rotational constants for the two states concerned are not appreciably altered by the extension. A. H.

1563. Absorption spectra of organic compounds in H_3PO_4 and H_2SO_4 solutions. F. BANDOW. *Zeits. f. phys. Chem. B*, **45**, 2, *pp.* 156–164, 1939.—The effect of solution in H_2SO_4 on the absorption spectra of organic compounds is investigated. In many cases the absorption is displaced towards longer wavelengths, the change occurring over a narrow range of acid concentrations, e.g., from 70 to 80% by weight. It is essentially a question of equilibrium between two forms of molecule, in which the dehydrating power of the acid is important. Comparison with the spectra in H_3PO_4 solutions supports this view; but other influences are also present. C. B. A.

1564. U.v. absorption of N_2O. J. NICOLLE AND B. VODAR. *Comptes Rendus*, **210**, *pp.* 142–144, *Jan.* 22, 1940.—The following results are recorded: (i) absorption is independent of pressure; (ii) it is weaker at − 90°C. than at + 20°C.; (iii) the ratio of the molecular extinction coefficients at these temperatures is independent of wavelength, and equals **2·95**; (iv) the absorption at − 90°C. begins at **2 350 Å**; (v) this absorption is one branch of the band at 1 900 Å. It is attributed to the photochemical dissociation of N_2O into NO + N with the N atom in its normal ^4S state. The absorption bands in the Schumann region are associated with similar dissociation, but with N in the ^2D and ^2P states. At ordinary temperatures

N_2O possesses excited vibrational states, and the potential energy curve for NO + N (^4S) rises rapidly. C. B. A.

1565. Band spectra of S_2 and Se_2. M. MIYANISI. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 955, *pp.* 79–84, *Feb.*, 1940.—The S_2 and Se_2 band spectra appeared in ignition flames of the mixture $2H_2 + O_2$ containing a small quantity of H_2SO_4 and Se respectively. They were also enhanced in discharge tubes of water vapour containing a small quantity of S and Se especially in the spectral regions where OH bands $2' \sim 1''$, $1' \sim 0''$ and $1' \sim 2''$, $0' \sim 1''$ appeared respectively. The author considers that the appearances of these bands in the ignition flames as well as enhancement of them in the discharge tubes are due to excited OH molecules. AUTHOR.

1566. Halogen molecule spectra. Part II. Interval relations and relative intensities in long wavelength spectra. R. S. MULLIKEN. *Phys. Rev.*, **57**, *pp.* 500–515, *March* 15, 1940.—Quantum-theoretical expressions are obtained for energy-intervals among the levels belonging to related $^3\Pi$ and $^1\Pi$ states of any diatomic molecule, for partial Ω,ω (J,j-like) coupling. A theoretical expression is also obtained for the relative intensities of spectroscopic transitions from a $^1\Sigma$ to the $^3\Pi_1$ and $^1\Pi$ states. The effect of partial case *c* coupling (persistence of separate-atom *J* quantization) on the foregoing relations is studied. Equations are obtained which (together with equations of Van Vleck) permit computation of case *c* displacements of certain energy levels of the halogen molecules. The foregoing relations are applied to a refinement of the existing interpretations of the long wavelength absorption spectra of the diatomic halogen molecules. In the case of Br_2, it is found impossible to decide between two alternative interpretations; suggestions are made for further work that could lead to a decision. Information is obtained bearing on the strength of the dissociation continuum overlying the bands in Cl_2, Br_2, and I_2, on the positions of the $^1\Pi$ and $^3\Pi_{0-u}$ potential energy curves in I_2 and on the cause of magnetic predissociation in I^2. The desirability of quantitative measurement of the infra-red continuum of iodine and careful remeasurement of the visible continuum of iodine chloride are mentioned. Two mechanisms (proposed by Van Vleck and the writer) for explaining the remarkably high intensity of the $^1\Sigma \rightarrow {}^3\Pi_{0+}$ component in the halogen spectra are examined. Both give calculated intensities approaching the observed in order of magnitude. The weak λ2250 bromine continuum is discussed; its occurrence and intensity seem to be explainable, by a case-*c*-allowed intersystem combination. [For Part I see Abstract 5063 (1934).] AUTHOR.

1567. Fluorescence spectrum and composition of scapolite. E. IWASE. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 953, *pp.* 58–64, *Jan.*, 1940.—The comparison of the fluorescence spectra given by the scapolites from North Burgess, Ontario, and Grenville, Quebec, affords an opportunity of making a thorough correction of the constitutional formula hitherto adopted for the well known fluorescent specimen from Grenville. With these scapolites it is found that the location of fluorescence bands due to the presence of U is definitely affected by the chemical composition of the specimens. Thus the conception of *Mischphosphor* can be applied to the luminescence of scapolite under u.v. excitation. [See Abstract 653 (1938).] AUTHOR.

1568. Raman and infra-red spectra of cyclopropane. B. D. SAKSENA. *Indian Acad. Sci., Proc. Sect. A*, **10**, *pp.* 449–467, *Dec.*, 1939.—The normal modes and force constants are calculated for a model having symmetry

D_{3h}, with hydrogens out of the plane of carbons. The frequencies of vibration are calculated, and fairly good agreement is obtained. The potential function assumed includes coupling terms between valence and deformation vibrations. A completely plane model is then investigated, and it is found to lead to discrepancies with observed frequencies. A. C. M.

1569. Potential function of plane vibrations of benzene molecule. E. Bernard, C. Manneback and A. Verleysen. *Ann. Soc. Sci. de Bruxelles*, **59,** *pp.* 376–402, *Dec.* 31, 1939.—It is now agreed that the benzene molecule has the symmetry D_{6h}. Various attempts have been made to determine the numerical values of the principal parameters of the potential function. All give values of the same order, with discrepancies of 5 to 10%. While some authors think this is the best that can be expected, the present authors believe that the accuracy of the experimental frequencies demands closer theoretical agreement. They therefore consider coupling terms, such as used previously for ethylene [see Abstract 2549 (1939)]. The function for the plane vibrations is calculated by using the known frequencies for C_6H_6 and C_6D_6, and is then tested by recalculating these frequencies using the function. An interesting feature of this function is the high value of the coefficient coupling deformation of sides with deformation of angles of the hexagon. The same potential function is to be used (in a later publication) to calculate the plane vibration frequencies of *sym*-$C_6H_3D_3$, *p*-$C_6H_4D_2$, and *p*-$C_6H_2D_4$. **Errata,** *ibid.*, 60, *p.* 59, *March* 9, 1940. A. C. M.

1570. Raman spectra of methylene derivatives. J. Wagner. *Zeits. f. phys. Chem. B*, **45,** 1, *pp.* 69–91, 1939.—The vibration-spectra of the methylene derivations $Y \cdot CH_2$–X with substituents CH_3, F, Cl, Br, I are analysed. The analysis is performed by considering the activity of the vibrations in the infra-red spectrum and in the Raman effect, and comparing with the activity to be expected for models with symmetries C_{2v} and C_s, and checking by rough calculations based on the simpler model $CH_2 \cdot X_2$. In the course of the work polarization observations in the Raman effect were made for nine derivatives. A. C. M.

1571. Spectral transition $XY_4 \rightarrow XZ_4$. K. W. F. Kohlrausch and J. Wagner. *Zeits. f. phys. Chem. B*, **45,** 2, *pp.* 93–100, 1939.—A correction is made to previous work [see Abstracts 2586 (1935) and 2913 (1938)]. The transitions in the Raman spectra are examined for series such as $CH_4 \rightarrow XCH_3 \rightarrow X_2CH_2 \rightarrow X_3CH \rightarrow X_4C$, and as special examples the series $CH_4 \rightarrow CCl_4$ and $CH_4 \rightarrow CBr_4$ are treated. If a particular model is adopted for a molecule, and then one considers a gradual transition in the mass of an atom, although the symmetry may be preserved, a vibration which is originally a valence vibration may go over into a deformation one, and vice versa. Again, if the transition CH_3-X $\rightarrow$ $CH \cdot X_3$ is considered, although both molecules possess symmetry C_{3v}, the C_3 axis concerned is a different one in the two cases, when they are considered to be derived from CH_4 by changing, say, H into X. It is shown how the relationships between frequencies of the different substances can be correctly determined. A. C. M.

1572. Raman effect of pentaerythritol and similar compounds. O. Ballaus and J. Wagner. *Zeits. f. phys. Chem. B*, **45,** 2, *pp.* 165–174, 1939.—Raman spectra are reported for substances having the formula $C(CH_2X)_4$ with X = OH, Cl, Br, I, in the form of powdered crystals, for molten $C(CH_2Cl)_4$, and for the liquid tetramethylether $C(CH_2OCH_3)_4$. Electron-diffraction experiments suggest that the tetrabromide and tetraiodide have the symmetry V_d, and the spectra are examined to see if they confirm this. The allocation of the lines to vibrations of the molecules is helped by considering the changes to be expected in the series of radicals $C(CH_3)_4 \rightarrow C(CH_2{\cdot}X)_4 \rightarrow C(CH_2)_4$. The halides are found to have the symmetry V_d. Pentaerythritol itself behaves somewhat differently. The changes in the spectrum of the chloride on melting are described, and they suggest that a second form of molecule may co-exist. A. C. M.

1573. Intensity of Raman lines in CCl_4. B. P. RAO. *Indian. Acad. Sci., Proc. A*, **11**, *pp.* 1–5, *Jan.*, 1940.—The relative intensity of the Rayleigh and total-symmetric Raman lines in CCl_4 is calculated, using Havelock's expression for the polarizibility of a tetrahedral molecule. The same intensity ratio was also determined experimentally by a photographic method. The observed value of 500 is of the right order of agreement with the theoretical value of 280. In the course of the work, the octave 1 538 was found to be polarized, although from a depolarized fundamental. This is in agreement with the expectations based on symmetry considerations. A. C. M.

1574. Raman spectrum and molecular association of formamide. B. D. SAKSENA. *Indian Acad. Sci., Proc. A*, **11**, *pp.* 53–61, *Jan.*, 1940.—The Raman spectrum of formamide was studied at various dilutions and at various temperatures, and the polarization of the lines was observed. Several new lines were found. The only effect of temperature was a shift of one line, 1 302, to a higher frequency, 1 309. Marked changes were observed on dilution. All the lines were polarized except two. The results suggest that the molecules are largely polymers, with a few monomers as well. A. C. M.

1575. Crystal orientation and Raman effect in calcite. S. BHAGAVANTAM. *Indian Acad. Sci., Proc. A*, **11**, *pp.* 62–71, *Jan.*, 1940.—Raman spectra are observed for polarized incident light on a calcite cube, cut so that faces are normal to and parallel with the optic axis. The spectrum of the scattered light was photographed through a double-image prism. The results obtained for the total symmetric vibration (1 084) and for the lattice vibrations (155 and 282) are in good agreement with expectation based on group-theory. The behaviour of the internal degenerate oscillations (709 and 1 434) are satisfactory, as far as can be seen, but owing to the weakness of these lines the results are not yet sure. A. C. M.

***1576. Null-type photoelectric spectrophotometer.** C. J. BARTON AND J. H. YOE. *Indust. and Engin. Chem.*, (*Analytical Edition*), **12**, *pp.* 166–168, *March*, 1940.—A null-type photoelectric spectrophotometer employing barrier-layer photocells is described. Details of construction and operation are given. Tests of the sensitivity, reproducibility and accuracy of the instrument are described. The instrument can be used for accurate spectrophotometric measurements, the study of colorimetric methods of analysis, and other types of absorption measurements. AUTHORS.

See also Abstract 1336, 1410, 1517, 1521, 1538, 1650.

TRANSMISSION.

1577. Velocity of propagation of light in vacuo in a transverse magnetic field. C. J. BANWELL AND C. C. FARR. *Roy. Soc., Proc. A*, **174**, *pp.* 1–25, *March* 28, 1940.—This paper is an account of work done to determine, to a higher degree of precision than before, the effect (if any) of a transverse magnetic field on the velocity of propagation of light in air at reduced pressure. The experimental results indicate that there is an increase in the velocity of light of 34·31 cm./sec., in a field in which the magnetic force was 20 000 oersted, in the presence of air at a pressure of 0·05 mm. of mercury. The probable error of the observations was found to be 18·56 cm./sec. An interferometer method, using the Michelson arrangement, was employed, one interfering ray passing through the field in the gaps of three electromagnets, and the other passing through free space. A photoelectric cell and amplifier were used in conjunction with a galvanometer, to record band movement on a moving photographic strip, the resulting record being subsequently measured by means of a planimeter. The mean of the results from a number of such records was taken, and preliminary check experiments carried out. The authors consider that they have taken all precautions to eliminate causes tending to give a spurious effect greater than the probable error of observation quoted above. They would however be very hesitant in accepting the above final result as real. All that can be said definitely is that in such a field (20 000 oersted) the effect is less than 1 part in about 5×10^8. AUTHORS.

1578. Near infra-red transmission of glucose glass. W. M. COHN. *J. Chem. Phys.*, **8**, *pp.* 232–243, *March*, 1940.—The transmission of samples of glucose glass varying in thermal history was previously investigated. This work covered the visible part of the spectrum. Transmission data in the near infra-red are presented now as far as could be obtained photographically (12 000 Å). No limit of absorption was found at long wavelengths as far as tested. The possible use of organic glass for investigations in the near infra-red is discussed. AUTHOR.

See also Abstract 1558.

VISION.

1579. Neural mechanism for discrimination. Part II. Discrimination of weights. A. S. HOUSEHOLDER. *Math. Biophysics, Bull.*, **2**, *pp.* 1–13, *March*, 1940.—A theoretical central mechanism for the discrimination of intensities as previously developed (*Psychometrika*, **4**, *pp.* 45–58, 1939), together with plausible assumptions concerning the receptors, are employed for the derivation of the discriminable difference between lifted weights as a function of the smaller of these weights. The function so derived depends upon three parameters, one parameter being the weight of the supporting member. Some empirical data are compared with the theoretical predictions, and a few remarks are added to describe the physiological significance of the parameters. [See following Abstract.] AUTHOR.

1580. Discrimination between temporally separated stimuli. H. D. LANDAHL. *Math. Biophysics, Bull.*, **2**, *pp.* 37–47, *March*, 1940.—A mechanism is discussed which has the property that two temporarily separated stimuli presented over a common path may be discriminated as though they had been presented simultaneously over separate paths. [See preceding Abstract.] AUTHOR.

1581. Theory of visual threshold. Part I. Time and intensity. W. J. CROZIER. *Nat. Acad. Sci., Proc.*, **26**, *pp.* 54–60, *Jan.*, 1940.—Some measurements of the visual threshold T for a test stimulus exposed for a time *t* indicate that for sufficiently short times *t* the product T*t* remains constant, a result which is related to the Roscoe-Bunsen rule of photochemistry. Other measurements suggest that the product T*t* exhibits a minimum. The author sketches certain views on the mechanism of threshold perception which indicate that the curve of I/T against log t should be fitted by a plot of the probability integral. It is shown that several sets of data including those in which Tt passed through a minimum can be fitted in this way. The effect of area of the stimulus on the relation between T and t is also examined. The author concludes that the Roscoe-Bunsen rule is not required to explain the threshold data discussed. W. S. S.

1582. Temperature and the critical intensity for response to visual flicker. Part IV. W. J. Crozier and E. Wolf. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 60–65, *Jan.*, 1940.—Continuing previous work [see Abstract 2923 (1939)] the authors show that the temperature shift of the critical flicker curve of the dark-adapted turtle *Pseudemys* is closely similar for flickering lights having light periods equal respectively to 10, 50 and 90% of the complete cycle. This result is consistent with the view that the temperature shift is independent of the shape of the critical frequency curve but is determined by the chemical character of the excitation process. W. S. S.

1583. Supra-threshold visibility. M. Luckiesh and F. K. Moss. *J.O.S.A.*, **30,** *pp.* 62–69, *Feb.*, 1940.—Describes methods of assessing the visibility of an object when this is well above the threshold and shows how a scale can be constructed to give a numerical value for the visibility of any object seen under defined conditions. The Luckiesh-Moss visibility meter is used for the purpose and the method by which supra-threshold values of visibility are measured is explained. J. W. T. W.

1584. Anatomical studies of the eye. S. R. Detwiler. *J.O.S.A.*, **30,** *pp.* 42–50, *Feb.*, 1940.—The characteristics which distinguish rods from cones are discussed. The receptors and their connections are described and illustrated for reptiles, fishes, amphibia, birds, mammals and man. The relation between retinal structure and animal habits is described and the dimensions of the receptors in various eyes are analysed in terms of the corresponding visual acuity. Diagrams are given showing sections of different eyes and several photomicrographs of the retina are included. Differences in the shape of the *fovea centralis* are illustrated by photomicrographs, and it is suggested that the production of a thin spot in this area of the retina is not essential for obtaining high visual acuity. W. D. W.

X-RAYS.

1585. Scattering of X-rays by liquid He II. J. Reekie. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 236–241, *April*, 1940.—In the first experiments described the normal Debye-Scherrer method was used, but in later experiments a new method and camera were used, for recording the scattered radiation. The details are given in full. An exposure of 18 hr. is required to obtain diffraction patterns from liquid He II. Photographs and microphotometric curves of them are obtained from liquid He II at temperatures of 1·15°K. and 2·15°K.; no marked difference between the two photographs can be observed. The main maximum of the diffraction rings occurs at 27·5°. Calculations have been made for the position of the maximum for various structures—simple close-packing, hexagonal close-packing and the diamond structure, but it was found impossible to come to any conclusion without making further experiments with a camera of higher resolving power, covering greater angles of scattering. G. G.

1586. Theoretical study of diffuse scattering of X-rays by crystals. W. H. Zachariasen. *Phys. Rev.*, **57,** *pp.* 597–602, *April* 1, 1940.—A new derivation is made of the intensity expression for the coherent scattering of X-rays by a small crystal. The accepted intensity formula

V.4
194

for the diffuse scattering—the well-known Debye formula—is shown to be incorrect and is replaced by a more complicated expression. According to the revised theory the intensity of the diffuse scattering varies much more rapidly with the scattering direction and exhibits a series of diffraction maxima. These maxima are found in the directions $\mathbf{k}_m$ satisfying equations of the type $(1 + \lambda\tau_{\min})\mathbf{k}_m = \mathbf{k}_0 + \mathbf{B}_H$, where $\mathbf{k}_0$ is the direction of incidence (with $k_m = k_0 = 1/\lambda$, the reciprocal wavelength) and $\mathbf{B}_H$ a reciprocal lattice vector. The consequences of the theory are discussed in detail. AUTHOR.

1587. X-ray dispersion in Cu crystals. E. M. McNATT. *Phys. Rev.*, **57,** *pp.* 621–624, *April* 1, 1940.—The diffuse scattering of Cu Kα radiation ($\lambda = 1{\cdot}54$ Å) from single crystals of Cu ($\lambda_k = 1{\cdot}38$ Å) has been measured for various scattering angles from $\phi = 40°$ to $120°$. Atomic structure factors, calculated from these measurements by combining them with the average temperature-modified structure factor values obtained by other workers using the powdered crystal reflection method, have been compared with Hartree theoretical atomic structure factor values for $\lambda \rightarrow 0$ to obtain the decrement caused by dispersion. The average decrement was found to be $\Delta f = 1{\cdot}75$ as compared with the Hönl value of $2{\cdot}8$ for this ratio of incident to critical absorption wavelength, $\lambda/\lambda_k = 1{\cdot}12$. No evidence for a dip in the atomic structure factor curve such as found with Zn was noted. Since Cu is a cubic crystal the atomic electron clouds are presumably spherically symmetrical and hence no dip in the S or f curves should be expected. AUTHOR.

***1588. Filters for X-ray absorption measurements on solid chemical compounds.** W. MEYER-CORDS. *Ann. d. Physik*, **36,** 7, *pp.* 651–679, *Dec.*, 1939.—Absorption measurements on heavy substances demand extremely thin filters such as may be difficult to obtain by routine methods. An experimental study was carried out with a view to producing filters by soaking ordinary filtering paper in an aqueous solution of the substance to be investigated. As it was impossible to obtain perfect distribution of material over the whole surface, sets of not less than 8 individual filters had to be used. The usual methods were employed for drying the filters; P_2O_5 proved superior to other hygroscopic substances. A special vacuum precision balance was designed and built for the determination of the filter mass. Difficulties due to the tendency of the dry filters to saturate when exposed to moisture could thus be avoided. The average weight of a set of 8 filters was of the order of 2 000 mg. that of the absorbing substance *ca.* 300 mg. The total weight as measured by the vacuum balance kept constant within $0{\cdot}3\,{}^0/_{00}$ over a period of several months. A number of inorganic compounds were investigated. The method seems to be applicable to most substances that can conveniently be dissolved in water. H. O. S.

1589. Emission and absorption of X-rays in zinc and zinc oxide. M. SATÔ. *Tohoku Univ., Sci. Reports*, **28,** *pp.* 398–409, *Feb.*, 1940. *Report No.* 467 *of the Research Inst. for Iron, Steel and Other Metals.*—The experimental result of M-absorption in Zn by Johnston [see Abstract 1262 (1939)] is explained as follows :—M_2 and M_3 edges measured by him are caused by the electron transitions from M_{II}- and M_{III}-shell to the atomic level (4s, 4p) ^3P, ZnI, respectively, and absorption maxima appearing in his curve are due to electron transitions among the levels, M_I, M_{II}, M_{III}, M_{IV}, M_V, $(4s)^2\ {}^1S_0$ ZnI and ∞. In the light of this result, the previous interpretation of L-absorptions of X-rays in Zn and ZnO are corrected. [See Abstract 1668 (1938).] AUTHOR.

1590. Fine structures in K-absorption edges of iron at low temperatures. S. AOYAMA AND T. FUKUROI. *Tohoku Univ., Sci. Reports,* **28,** *pp.* 410–422, *Feb.,* 1940. *Report No.* 468 *of the Research Inst. for Iron, Steel and Other Metals.*—Fine structures in the K-absorption spectra of Fe and its compounds—cementite, magnetite and hematite—are investigated both at room and liquid-air temperatures. The temperature effect on the structures, especially on those remote from the principal edge, is noted for metallic iron and magnetite. The wavelengths of the principal absorption edge are also compared for various kinds of iron compounds. AUTHORS.

1591. M- and N-spectra of Pd and Ag. N- and O-spectra of Au from 90 Å to 200 Å. H. SAUVENIER. *J. de Physique et le Radium,* **1,** *pp.* 63–67, *Feb.,* 1940.—By the study of the spectra of Pd, of Ag and of Au in the intermediate region rays highly enlarged by the Auger effect have been obtained as well as bands of free electrons of these metals These new rays have been completely identified. The measurement of the width of the electron bands allows the taking into account of the electrical properties of the metals concerned as well as of the paramagnetic properties of Pd. A better estimation of the value of the mean internal potential of these metals has also been obtained. J. J. S.

1592. L-absorption spectra of U, Pt, and W. Y. CAUCHOIS AND I. MANESCU. *Comptes Rendus,* **210,** *pp.* 172–174, *Jan.* 29, 1940.—The L-absorption spectra of U, Pt and W have been studied. Discontinuities have been measured in the first and second orders at the 201 plane and in the first order at the 100 plane. The results for the wavelengths and energy levels deduced on the basis of the absorption frequency L_{III} found here, are given in tabular form. G. O. B.

1593. X-ray spectral distribution from absorption data. D. E. A. JONES. *Brit. J. of Radiology,* **13,** *pp.* 95–101, *March,* 1940.—Attempts to apply the formulae of Silberstein [see Abstract 1928 (1933)] relating absorption data with the spectral distribution of a heterogeneous X-ray beam, to experimental results have shown very serious discrepancies. The empirical relation $I_x = I_0 e^{-Ax-B\sqrt{x}}$, suggested by Silberstein to represent the transmission of a heterogeneous beam, has therefore been further analysed. It is shown that to bring the equation into line with experimental results, a further constant is required. The exponent then becomes $-Ax - B(\sqrt{x+d} - \sqrt{d})$. The methods of evaluating the constants, A, B and d are described. Using the modified formula, it is shown that the spectral distribution of intensity in the continuous part of a heterogeneous beam can be determined directly from the absorption curve in any filtering material. **Erratum,** *ibid. p.* 135, *April,* 1940. J. E. R.

***1594. Rotary shutter for X-rays.** H. E. SEEMANN AND W. C. VAETH. *Kodak Research Lab., Comm. No.* 747. *Rev. Sci Instruments,* **11,** *pp.* 86–87, *March,* 1940. *Brit. J. of Radiology,* **13,** *pp.* 183–184, *May,* 1940.—A shutter for an X-ray beam consists principally of a rotary disc with alternate open and opaque sectors, and a suitable control mechanism operated by an electromagnet. Several exposures may be made for one winding, a feature of convenience when remote control is desired. The motion of the disc is the same for opening and closing so that each part of the beam is turned on for the same length of time. The shutter will accommodate an X-ray beam directed anywhere between the vertical and the horizontal. AUTHORS.

See also Abstracts 1351, 1359, 1666, 1667.

HEAT.

CALORIMETRY.

✱1595. Results of desorption experiments. A. VAN ITTERBEEK AND W. VAN DINGENEN. *J. de Physique et le Radium*, **1**, *pp*. 25–28, *Jan*., 1940.—A desorption apparatus designed and constructed by the authors is described. Temperatures between 90° and 35°K. were realized with H_2 as adsorbed gas on activated charcoal and temperatures between 20° and 6°K. with He gas. By means of this apparatus the specific heats of He and H_2 in the adsorbed state were determined. The values obtained are: 2·14 cal./mol. for He at 19·16°K. and 6.48 cal./mol. for H_2 at 77·48°K. Thus He may be considered to behave as a two-dimensional gas. The interpretation of the excessively high value for the specific heat of adsorbed H_2 presents considerable difficulty. [See Abstract 3111 (1938).] S. W.

✱1596. Resonance method for measuring C_p/C_v. A. L. CLARK AND L. KATZ. *Canad. J. of Research, A*, **18**, *pp*. 23–38, *Feb*., *and pp*. 39–63, *March*, 1940.—This paper contains the description with theory of a modification of Assmann's method for determining $\gamma = C_p/C_v$, the ratio of the specific heats of a gas. The gas is enclosed in two chambers formed by the ends of a cylinder and a steel piston in the middle of the cylinder. This piston is caused to oscillate by an alternating current applied in coils outside the cylinder, thus subjecting the gas to alternate compression and rarefaction. The system has a natural frequency depending on the constants of the apparatus and the value of γ peculiar to the gas. The frequency of the a-c. current is varied, the amplitude of the motion of the piston observed, and the frequency for resonance measured. From this frequency and the constants of the apparatus the value of γ is determined. The method yields results of great accuracy and reproducibility. [See Abstract 1925 (1929).] AUTHORS.

1597. Specific heats of H_2O and D_2O. A. H. COCKETT AND A. FERGUSON. *Phil. Mag*., **29**, *pp*. 185–199, *Feb*., 1940.—A method for measuring specific heats is developed which uses only small samples of the liquid, and aims at a determination of the specific heat at a given temperature with an error of less than 1 in 1 000. The method consists in measuring the rate of change of temperature for a given temperature difference between the calorimeter and its surroundings, and the heat input necessary to keep the temperature constant. Tables are given for the specific heat of H_2O between 16 and 38°C., and that of D_2O between 12 and 30°C. R. P.

See also Abstract 1618.

CONDUCTION.

✱1598. Thermal conduction of gases by a relative method with an application to D_2. W. G. KANNULUIK. *Roy. Soc., Proc. A*, **175**, *pp*. 36–48, *March* 28, 1940.—The paper describes a "hot wire" method of determining the thermal conductivity of any gas relative to that of H_2. The use of short, thick wires enables a simple, approximate theory to be given. The apparatus employed is of the double tube kind and consists of a pair of similar metal tubes each containing a thick Ni wire. These two wires are used as the nearly equal ratio arms of a Kelvin double bridge. The method is applied to measure the thermal conductivity of D_2. At 0°C.

the ratio of the conductivity of H_2 to that of D_2 is found to be equal to 1·365. AUTHOR.

1599. Thermal conductivities of solidified C_6H_6, HBr and N_2O. A. EUCKEN AND E. SCHRÖDER. *Ann. d. Physik*, **36,** 7, *pp.* 609–620, *Dec.*, 1939.—Measurements of the thermal conductivities of solidified liquids and gases are made by means of the Schleiermacher method. Results are given for benzene between 90° and 273°K., HBr between 78° and 142°K. and for N_2O between 90° and 150°K. The thermal conductivity of benzene is inversely proportional to the absolute temperature. That of HBr shows a discontinuity and a hysteresis effect. The conductivity of N_2O is considerably less than that of CO_2, although both substances are similar in crystal structure and in their other physical properties. The discussion of the results leads to the conclusion that both solid HBr and N_2O form a molecular lattice whose torsional movement under certain circumstances adds a considerable contribution to the total heat conductivity. R. W. P.

CONVECTION.

1600. Inversion point of convection currents. C. CODEGONE. *Accad. Sci. Torino, Atti*, **75,** *Disp.* 1*a*, *pp.* 167–171, *Nov.–Dec.*, 1939.—A round-bottomed flask containing water was slowly heated up or cooled down, and readings of the temperature θ at the centre of the mass of water taken at regular intervals of time t. The rate of temperature rise or fall, $d\theta/dt$, shows a marked diminution in the neighbourhood of the temperature θ_m of maximum density. This effect is ascribed to the fall in the rate of convection, and its inversion at θ_m. S. J. G.

1601. Instantaneous electroconvective motion. D. AVSEC. *Comptes Rendus*, **210,** *pp.* 76–78, *Jan.* 8, 1940.—The formation of electroconvective bands in a moving layer of smoke-charged air when an electric field is first applied is described and illustrated. This distinctive formation disappears in rather less than 1 min. as did that previously observed with an insulating fluid [see Abstract 802 (1940)]. The phenomenon is thought to be due to some of the smoke particles being either positively or negatively charged. R. W. P.

DILATATION.

See Abstract 1380.

FUSION AND SOLIDIFICATION.

1602. Physical properties of alkyl fluorides. A. V. GROSSE, R. C. WACKHER AND C. B. LINN. *J. Phys. Chem.*, **44,** *pp.* 275–296, *March*, 1940.—In Part I of this paper measurements are given of the following physical properties—melting and boiling points, vapour pressures, densities, indices of refraction, and their respective temperature coefficients—for methyl, ethyl, normal propyl, secondary proypyl, secondary butyl, tertiary butyl, and tertiary amyl fluorides. Reliable literature data on other fluorides are included. With the data now available it is possible to make a general comparison of the fluorine alkyls with the other halogen alkyls, as well as with alkyls of neighbouring elements of period II of the periodic table. Such a comparison is made in Part II. AUTHORS.

1603. Influence of interfacial tension on grain-size during solidification of alloys. P. BASTIEN. *Comptes Rendus*, **210,** *pp.* 248–250, *Feb.* 12, 1940. —The effect of progressive addition of Mg, Fe or Si to 99·998% pure Al has been studied, a marked diminution in grain size being produced. The phase diagrams show that peritectic transformations, which might otherwise explain the effect, are absent. Measurements of the interfacial tensions of the respective alloys against molten cryolite show that the admixed element produces a very large drop in interfacial tension, e.g. 0·1% Fe lowers that of Al from 168 to 77 dynes/cm., and the noted reduction in grain size is therefore probably due to this factor. S. J. G.

See also Abstracts 1333, 1356, 1618.

TEMPERATURE.

***1604. New Atmos engine.** H. Bock. *Zeits. f. Instrumentenk.*, **59,** *pp.* 448–450, *Nov.*, 1939.—The earlier apparatus [see Abstract 2077 (1938)] has been improved to obtain a great efficiency and reliability. In a strong outer zinc case another box with corrugated sides is fixed firmly at the base. The upper flat surface is connected by a chain and spring to a rotating wheel operating outside the boxes. A small amount of C_2H_5Cl, which has a low boiling point, is contained between the boxes. With rise of temperature the increased vapour pressure compresses the lid of the inner box and rotates the wheel. A calibration curve for temperature is obtained and the range can be varied by changing the amount of liquid. Numerical values are given. R. S. R.

***1605. Easily constructed, rugged, sensitive thermopile.** H. F. Launer. *Rev. Sci. Instruments*, **11,** *pp.* 98–101, *March*, 1940.—A thermopile consisting of chromel *p*-constantan junctions is described. Since the thermoelectric power of this couple is relatively high (over 60 μV/deg.C.) and since the metals have a low thermal conductivity and are easily worked, a sensitive, rugged thermopile may be constructed to meet individual needs in a short time without previous experience. A very simple technique of construction is described and the characteristics of a finished instrument are given. Author.

1606. Temperature concept. A. G. Worthing. *Am. J. Phys.*, **8,** *pp.* 28–30, *Feb.*, 1940.—Temperature is ordinarily treated as a quantity which is fundamental in heat problems although there are those who consider temperature is just a convenient term for the average translational kinetic energy of a molecule of the body under consideration. This paper considers whether or not temperature or some other quantity in the field of heat involving temperature may be viewed in this or some similar manner and expressed in terms of the basic mechanical quantities mentioned. S. A. S.

See also Abstracts 1378, 1425, 1585, 1590, 1599.

THERMOCHEMISTRY.

1607. Heat of dilution of aqueous HCl. J. M. Sturtevant. *Am. Chem. Soc., J.*, **62,** *pp.* 584–587, *March*, 1940.—The heat of dilution of HCl solutions at 25° has been measured up to a concentration of 3·3 molal. From these data have been calculated the apparent and partial relative molal heat content of the solute, and the partial relative molal heat content of the solvent. Author.

1608. Heat of ionic dissociation of RbCl and RbBr. B. N. Srivastava. *Nat. Inst. Sci., India, Proc.*, **5,** 3, *pp.* 313–323, 1939.—The thermal dissociation of RbCl and RbBr vapours into their ions has been experimentally investigated in the temperature region 1350–1550°C. with the help of an apparatus already described by the author elsewhere. The concentrations of the positive alkali ion, the negative halogen ion and the electron inside the furnace have been measured and from these the equilibrium constant of ionic dissociation at different temperature has been deduced. A theoretical formula then enables the heat of ionic dissociation of the salt to be calculated, the values obtained being 114·6 kg.cal for RbCl and 106·9 kg.cal for RbBr. Using the Born cycle the value of the electron affinity of Br is found from these measurements to be 79·5 kg.cal. and the heat of dissociation (atomic) of RbCl equal to 104·6 kg.cal. These results in general agree with other known determinations. AUTHOR.

1609. Thermal explosion of diethyl peroxide. E. J. HARRIS. *Roy. Soc., Proc. A,* **175,** *pp.* 254–261, *April* 10, 1940.—Further measurements on the critical explosion pressure of diethyl peroxide have been made in vessels of different dimensions. The conditions determining the explosion of diethyl peroxide have been shown to be in accord with those predicted by the thermal theory. The increased conductivity caused by H_2 and He does not cause a corresponding increase in the critical pressure, which may be due to inefficient energy transfer. The behaviour of azomethane and of ethyl azide is compared and shown to be similar. AUTHOR.

See also Abstracts 1338, 1339, 1369.

THERMODYNAMICS.

1610. Thermodynamics of concentrated aqueous NaOH solutions. G. ÅKERLOF AND G. KEGELES. *Am. Chem. Soc., J.,* **62,** *pp.* 620–640, *March,* 1940.—The e.m.f. of the cell $\mathrm{Pt,H_2} \mid \mathrm{NaOH}(m_1) \mid \mathrm{Na_xHg} \mid \mathrm{NaOH}(m_2) \mid \mathrm{H_2,Pt}$ has been measured at a large number of hydroxide concentrations from 0·1 to 17 molal over the temperature range 0 to 70° using a considerably improved experimental procedure. The water transfer potential of the cell was calculated by a direct method eliminating tedious successive approximations. The activity coefficient of the hydroxide for the concentration range 0·1 to 12 molal was found to be expressed adequately by the equation $\log \gamma = -u\sqrt{m}/(1 + \sqrt{2m}) + Bm + Cm^2 + Dm^3 + Em^4$, where u is the universal constant of the limiting law, m the molality of the hydroxide, B, C, D and E empirical constants varying according to second-order equations with the temperature. At higher concentrations a second-order equation was used for the calculation of $\log \gamma$. The curves for $\log \gamma$ do not within the experimental accuracy show any breaks at higher concentrations like those of the apparent partial molal volumes. Using the formulae for $\log \gamma$ equations have been given for the calculation of the activity and vapour pressure of the solvent, the relative partial molal free energy, heat content, entropy, and heat capacity of both solute and solvent. Other properties that have been discussed are the total heat capacity, specific heat and relative heat content of the solutions, the heat of dilution between two finite concentrations, differential and integral heats of vaporization of the solvent and finally the effect of pressure upon the thermodynamic properties of NaOH. The computed values of most of the properties treated are given in a series of tables. AUTHORS.

1611. Analytical calculations of thermodynamic properties. H. M. ROBINSON AND H. BLISS. *Indust. and Engin. Chem.,* **32,** *pp.* 396–398, *March,* 1940.—Equations for calculating entropy, enthalpy, and energy changes in terms of volume are derived for the van der Waals, Wohl, and Beattie-Bridgeman equations of state. They are tested for entropy and enthalpy calculations by comparisons with published values determined graphically. The Beattie-Bridgeman equation is satisfactory to 5–7%

V.4
194

for entropy and 12% for enthalpy determinations. The others are almost as good for entropy calculations but definitely inferior for enthalpy. AUTHORS.

1612. Calculation of third-law entropy of ethyl chloride. J. W. LINNETT. *Faraday Soc., Trans.*, **36**, *pp.* 527–533, *April*, 1940.—The entropy of ethyl between 273° and 573°K. has been calculated both assuming restricted and assuming free rotation of the methyl group. By combining these results with the calculated entropies of ethylene and hydrogen chloride the entropy change for the reaction $C_2H_5Cl = C_2H_4 + HCl$ has been calculated for the same range of temperature. From data on the equilibrium in the above system it has been possible to obtain an experimental value for the entropy change at 200°C. It is found that the calculated and experimental values at this temperature are widely different, and it is concluded that the experimental result is in error. The practicability of using the entropy change for this reaction to obtain information regarding the problem of internal rotation in ethyl chloride is discussed. AUTHOR.

1613. Theory of galvanic cells subject to fields of force. Part I. Gravitational field. F. O. KOENIG AND S. W. GRINNELL. *J. Phys. Chem.*, **44**, *pp.* 463–482, *April*, 1940.—With the help of the condition for quasi-reversible conduction [see Abstract 823 (1940)], general equations are deduced which express the e.m.f. of a galvanic cell subject to arbitrary gradients of the gravitational potential and of the mole fractions, as a function of the chemical state at every point and of the configuration. It is shown that, when the gravitational field strength is zero, these equations reduce to the general equations for cells with liquid-liquid junctions, whence the e.m.f. becomes independent of the gravitational potential. The electric p.d. in a solution subject to a gravitational field is calculated as a function of chemical state and configuration and is shown to be thermodynamically indeterminate. From the general equations the laws for certain special types of cell of experimental interest are deduced in detail. Previous theoretical work on galvanic cells subject to gravitational fields is reviewed. AUTHORS.

1614. Thermo-hydrodynamics of perfectly perfect fluids. Part I. D. VAN DANTZIG. *K. Ned. Akad. Wet., Proc.*, **43**, **3**, *pp.* 387–402, 1940. *In English.*—The equations of motion of a perfectly perfect (in particular of a relativistically perfect) fluid are brought into a general invariant form, independent of metrical geometry. They are shown to be derivable from a simple variational principle. It states that the integral of the pressure over an arbitrary 4-dimensional domain in space-time, under a deformation " dragging along " the chemical parameters λ^r and the temperature vector θ^h, hence also the congruence of macroscopic worldlines is equal to δx^4 times the virtual heat of the deformation, flowing through the boundary into *U*, a part of space-time, bounded by a differential 3-dimensional manifold *B*. Some other variational relations are derived. A result due to Eisenhart and used by Synge is obtained by metrical specialization from a one-dimensional variational principle. AUTHOR.

See also Abstracts 1366, 1369, 1401, 1425, 1453, 1602, 1617, 1642 and 683B. Gas kinetic processes in an expansion cylinder. W. Meissner and G. Meissner.

VAPORIZATION AND CONDENSATION.

1615. Boiling points of Mg and of Mg-alloys. A. SCHNEIDER AND U. ESCH. *Zeits. f. Elektrochem.*, **45**, *pp.* 888–893, *Dec.*, 1939.—A simple method is described for the determination of the boiling point of Mg and of its alloys. The result 1 103° ± 5°C. has been obtained for the b.p of Mg, in good agreement with the most reliable results in the literature. Mg alloys containing up to 40 atomic % of Al, Ag, Cu, Sn or Pb give a b.p. elevation proportional to the concentration of the added metal, showing that up to this concentration these alloys in the fused state act as "ideal concentrated mixtures." S. J. G.

1616. Boiling points of n-heptane and 2,2,4-trimethylpentane over the range 100- to 1 500-mm. pressure. E. R. SMITH. *Bureau of Standards, J. of Research*, **24**, *pp*. 229–234, *March*, 1940.—By a comparative dynamic method, using water as the reference standard and ebulliometers of the Swietoslawski type, data were obtained from which were developed the following equations to express the relationship between temperature and vapour pressure from 100 to 1 500 mm.: For *n*-heptane, $\log_{10} p = 6{\cdot}905\,113 - 1269{\cdot}821/(217{\cdot}110 + t)$. For 2,2,4-trimethylpentane, $\log_{10} p = 6{\cdot}820\,137 - 1\,262{\cdot}707/(221{\cdot}307 + t)$. In these equations, p is the vapour pressure in standard mm. of Hg exerted by the substance at the temperature t in deg. C. AUTHOR.

1617. Azeotropic system alcohol-water-benzene. W. D. BONNER AND M. B. WILLIAMS. *J. Phys. Chem.*, **44**, *pp*. 404–408, *April*, 1940.—This study shows that the effect of changing pressure on the water content of the heavier phase in heterogeneous systems of alcohol-water-benzene is greatest at low pressures, and that it becomes small and approximately constant at about 1 atm. pressure. It also shows the ready applicability of the method of Barbaudy [*Bull. Soc. Chim.* **39**, *p*. 371, 1926] to the analysis of such systems. AUTHORS.

1618. Vapour pressures, heats of vaporization and melting points of N^{14} and N^{15} ammonias. H. G. THODE. *Am. Chem. Soc., J.*, **62**, *pp*.581–583, *March*, 1940.—The vapour pressure difference between 70·6% $N^{15}H_3$ and ordinary ammonia has been measured for the liquids over a range of temperatures by means of a differential oil manometer. The vapour pressure data for the liquids can be represented by the equation: $\log_{10}(P_1/P_2) = 0{\cdot}9593/T - 0{\cdot}00325$, where P_1 is the vapour pressure of ordinary ammonia and P_2 that of the 70·6% material. The vapour pressure of ordinary ammonia is 0·371 and 0·174% higher than the heavy ammonia sample at 195°K. (triple point of ammonia) and 239·68°K. (n.b.p.), respectively. The heavier sample of ammonia has a heat of vaporization 4·39 cal./mol. higher than that of ordinary ammonia. The triple points of the two samples differ by 0·081°, that of the 70·6% material being higher. [See also Abstract 477 (1939).] AUTHOR.

See also Abstract 1421.

ACOUSTICS.

1619. Density of energy in acoustic problems. G. SACERDOTE. *Pont. Acad. Sci., Acta*, **3**, **6**, *pp*. 47–52, 1939.—In many acoustical problems, particularly in those of the distribution of sonorous energy and of the course of the sound wave in a definite medium the density of energy is taken as fundamental parameter. In fact the analytical expression of

V.4
194

such phenomena as function of the density of energy has a simpler form than when presented as function of the pressure. The density of energy may be considered as a parameter to be considered by itself. This density is defined as follows: $E = \frac{1}{2}(\rho V^2 + P^2/\rho c^2)$ and is the sum of the kinetic and potential energies per unit of volume; ρ = density of medium, c = velocity of sound, V = velocity of displacement, P = sonorous pressure. After treating the general equations of propagation the author deals with certain applications to architectural acoustics which become more simple by means of this method. J. J. S.

1620. Inertia of the régimes in oscillating fluids. Z. Carrière. *J. de Physique et le Radium*, **1**, *pp.* 68–73, *Feb.*, 1940.—Considering the case in which aerodynamic resistances with variable incidence are exerted and the case of the multiple régimes of a sonorous tube, it is shown how the inertia term enables the different singularities, observed during the transition from one régime to another, to be foreseen. By the same inertia are explained the principal singularities observed in a previous study [see Abstract 3891 (1931)] of acoustic velocities in the neighbourhood of various solid obstacles—circular cylinder, rigid plane, vibrating sheet. Four stationary trajectories experimentally determine the position, periodicity and the direction of the course traversed. J. J. S.

1621. Edge tones. J. M. A. Lenihan and E. G. Richardson. *Phil. Mag.*, **29**, *pp.* 400–406, *April*, 1940.—Experiments are described on the tones which are heard when air issuing from a slit strikes a parallel wire. The tones are shown to be of the same nature as edge tones. In the velocity gradient on either side of the slit the wire may be set into vibration at its natural frequency. The significance of the observations for edge-tone theories is discussed. [See Abstract 4620 [(1937).] Authors.

1622. Supersonic measurement of elastic constants of isotropic solids. R. Bär. *Helv. Phys. Acta*, **13**, 1, *pp.* 61–76, 1940. *In German.*—A rectangular prism is cut from the solid to be investigated and one end is inclined at about 45° to the axis. To this end is cemented a piezoelectric quartz slice capable of generating a suitable supersonic frequency. The test piece is immersed in a transparent fluid and the transverse and longitudinal waves generated in the test piece, owing to refraction and internal reflection effects, give rise to interference effects in the surrounding fluid which can be observed by suitable optical arrangements. Measurements of the interference bands thus obtained give the directions and propagation velocities of the two waves. For a glass bar the longitudinal velocity was found to be about 5 600 m./s. and the transversal about 3 530 m./s., the corresponding values for iron being 5 770 and 2 950 m./s., the accuracy being of the order of 10%. A. W.

1623. Diffraction of light by supersonic waves in liquids. A. W. Smith and L. M. Ewing. *Am. J. Phys.*, **8**, *pp.* 57–59, *Feb.*, 1940.—A simplified apparatus suitable for lecture demonstrations and allowing fairly accurate measurements is described. The essential features are a simple table spectrometer serving as the collimator, and a telescope and scales for angles. The monochromatic light source is a Na lamp. The supersonic waves are generated by a quartz crystal immersed in a glass trough, or, for examination of conducting liquids, in an inner cell of Cu containing xylene or toluene. From measurements made the speed of the waves and the adiabatic compressibility of the liquid are calculated. Data are given for H_2O, C_6H_6, CCl_4, toluene and xylene. N. M. B.

1624. Dispersion of supersonic waves in cylindrical rods of polycrystalline Ag, Ni and Mg. S. K. SHEAR AND A. B. FOCKE. *Phys. Rev.*, **57**, *pp.* 532–537, *March* 15, 1940.—The velocities of elastic waves in polycrystalline rods of Ag, Ni and Mg were measured at supersonic frequencies ranging from 120 to 750 kc./s. This was done by mounting the rods in a horizontal position so that one end was supported by a loop of silk thread and the other end passed through a diaphragm into a special box which was filled with a transformer oil and which contained the quartz crystal source of supersound. Lycopodium powder scattered along the rod formed wave patterns when the rod was vibrating resonantly and hence wavelengths could be measured directly. The products of these wavelengths and the corresponding frequencies as read on the wave meter yield the required velocities. The dispersion theory of Giebe and Blechschmidt was tested by calculating theoretical curves for 4 of the 6 rods comparing these with the corresponding experimental curves. The theory is found adequate to account satisfactorily only for the low frequency dispersion. One reason for its failure in other respects is discussed. AUTHORS.

See also Abstract

883B. Artificial larynx for speaking and choral singing by one person. F. A. Firestone.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***1625. Vacuum tubes in the physics laboratory.** G. P. HARNWELL AND L. N. RIDENOUR. *Am. J. Phys.*, **8**, *pp.* 79–99, *April*, 1940.

CONDUCTION AND DISCHARGE IN GASES.

1626. Ionization loss of energy in gases and in condensed materials. E. FERMI. *Phys. Rev.*, **57**, *pp.* 485–493, *March* 15, 1940.—It is shown that the loss of energy of a fast charged particle due to the ionization of the material through which it is passing is considerably affected by the density of the material. The effect is due to the alteration of the electric field of the passing particle by the electric polarization of the medium. A theory based on classical electrodynamics shows that by equal mass of material traversed, the loss is larger in a rarefied substance than in a condensed one. The application of these results to cosmic-radiation problems is discussed especially in view of the possible explanation on this basis of part of the difference in the absorption of mesotrons in air and in condensed materials that is usually interpreted as evidence for a spontaneous decay of the mesotron. AUTHOR.

1627. Low-pressure Hg arc. Anchored cathode spot. N. WARMOLTZ. *Physica*, **7**, *pp.* 209–216, *March*, 1940. *In English.*—In low-pressure arcs with a Hg pool cathode the cathode spot usually wanders erratically over the Hg surface. If, however, a metal which is wetted by the Hg projects through the Hg surface, the cathode spot is anchored to the Hg-metal boundary, giving a cathode line. Most metals show this anchoring effect, Ni and Pt being quite stable. Anchoring on a Ni strip was also observed with cathodes of molten Sn, Cd, Na, Bi and a number of amalgams. Measurements were made of the dependence of the current necessary to free the spot on the temperature of the anchoring metal and on the rate of evaporation of Hg with different anchoring metals. Experiments in connection with the wetting of the anchor appear to indicate that a thin film of Hg on the anchor is essential for the anchoring process. This may be connected with the lowering of the work function of a metal surface by a monatomic layer of another metal, although the observed films are much thicker than this. A. W.

1628. Preferential and initial ionic recombination in gases. N. E. Bradbury. *J. of Applied Physics*, **11**, *pp.* 267–273, *April*, 1940.—In an attempt to determine the fraction of ions lost by recombination in an X-ray ionization chamber, a theory has been developed for the processes involved in preferential and initial ionic and electronic recombination. The theory considers the change of the energy distribution of the electrons as they diffuse away from the parent atom. From this, together with a knowledge of the electron capture process, the space distribution of negative ions formed may be obtained. The probability of the initial electron recombining preferentially with the parent positive ion is considered as well as the preferential process for the negative ion. Knowing the initial spacing of the ions, it is possible to calculate the recombination occurring during the diffusion process until random distribution is reached. The final volume recombination may then be calculated in the usual manner. The theory may be employed in both electronegative and free electron gases and to ions formed in the presence or absence of an electric field. Author.

1629. Neutralization cross-section and angular distribution in collisions between He^+ and He. N. Dallaporta. *Accad. Sci. Torino, Atti*, **75**, *Disp.* 1a, *pp.* 101–114, *Nov.–Dec.*, 1939.—The neutralization cross-section and the angular intensity distribution of scattered ions and neutralized atoms has been calculated for 3 velocities of the incident ion in collisions between a He^+ ion and a He atom. The total neutralization cross-section decreases with increasing velocity of the incident ion. The function representing the number of ions neutralized or scattered under a certain angle passes through a series of maxima and minima if the angle is varied. L. K.

See also Abstracts 1513, 1531, 1532, 1633.

CONDUCTION IN SOLIDS AND LIQUIDS.

1630. Properties of superconducting colloids and emulsions. D. Shoenberg. *Roy. Soc., Proc. A*, **175**, *pp.* 49–70, *March* 28, 1940.—Magnetization curves of colloids and emulsions of Hg are described which provide direct evidence for an appreciable penetration, increasing with temperature, of magnetic fields into small superconductors. From the temperature variation of χ/χ_0 (the susceptibility ratio of a small to a large sphere) for a very fine colloid, the temperature dependence of the penetration depth λ is deduced, in fair agreement with the results of Appleyard *et al.* This is used to transform the temperature dependence of χ/χ_0, for an emulsion with $r > \lambda$, into a curve of χ/χ_0 against λ/r, which is compared with a theoretical curve based on the Londons' penetration law, suggesting that the latter is only qualitatively valid. The critical fields h of the colloids and emulsions were larger than for bulk Hg, and it is shown how, together with the susceptibility data, they can be used to calculate the free energy difference per unit volume between superconducting and normal phases for a small sphere. The results suggest that this difference increases (if at all) by a factor of at most 2 or 3, when the size is reduced from macroscopic dimensions to 5×10^{-6} cm. The shape of the magnetization curves and various hysteresis features are found to differ between a small and a large sphere, and these differences are discussed. AUTHOR.

1631. Conductivity measurements on potassium halides. C. G. BRENNECKE. *J. of Applied Physics,* **11,** *pp.* 202–207, *March,* 1940.—The electrical conductivities of flat crystal plates of KBr and KCl were measured over a temperature range of from 25°C. to 600°C., at stresses of from 0·05 to 0·90 kV/cm. Ohm's law was found to hold, when cold conductivities were measured after preliminary heating. Current-time data indicated an exponential decay of current with time at the lower temperatures, and a current constant with time at the higher temperatures. An exponential relation between conductivity and temperature was found to hold for both KBr and KCl, but in the latter case an abrupt change in the slope of the curve was found to take place at a temperature between 200°C. and 250°C. AUTHOR.

See also Abstracts 1333, 1625, 1637 and

735B. D.c. amplifier of bridge type. L. Sponzilli.
808B. Quantitative treatment of the space-charge and boundary-layer theory of the crystal rectifier. W. Schottky and E. Spenke.

DIELECTRICS AND CAPACITANCE.

1632. Dielectric constant of ionized air. Part III. F. RAHMAN AND S. R. KHASTGIR. *Phil. Mag.,* **29,** *pp.* 344–352, *April,* 1940.—In the present investigation experiments were performed with external condenser plates round a discharge-tube on the effective dielectric constant of ionized air inside such a tube having different pressures and carrying different currents. For each different tube current and pressure the electron density and the electron temperature in the region of the experimental condenser were determined by the probe method of Langmuir. The results of the experiments, which revealed the previously reported anomalous variation of the dielectric constant of the ionized air, were found consistent with the theory that the anomalous values are due to the formation of a positive ionic sheath on the inner surface of the discharge-tube. [For Part II see Abstract 2984 (1938).] AUTHORS.

1633. Dielectric constant and electrical conductivity of gases and vapours ionized by X-rays at ultra-high radio frequency. S. R. KHASTGIR AND F. RAHMAN. *Phil. Mag.,* **29,** *pp.* 353–366, *April,* 1940.—A study was made of the dielectric constant change and the conductivity effect in gases ionized by varying intensities of X-rays, obtained by filtration through Al sheet, at constant and varying pressures, using a different arrangement of the oscillatory circuit from that of earlier experiments [see Abstract 329 (1914)]. The shift of the voltage or the current resonance point on ionizing air, SO_2, A, and a mixture of CH_3I and C_2H_5Br was studied. In all cases a positive shift was observed, gradually diminishing with reduction in the X-ray intensity. For varying gas pressure and constant X-ray intensity the shift was independent of the pressure. These results indicate that there must be a diminution in the effective dielectric constant of the gaseous medium on ionization, a change which is possible if it is assumed that the ejected photo-electrons remain in a free state at least for a small part of the time of exposure to X-rays. The h.f. electrical conductivity of

V.4
194

A and SO_2, measured for different pressures by a resonance curve method, was of the order 10^4 or 10^5 e.s.u., and diminished with increase of pressure, as expected from theory. N. M. B.

***1634. Experimental condenser for determination of dielectric constants of liquids.** D. T. Williams and C. S. Copeland. *Rev. Sci. Instruments,* **11,** *pp.* 105–107, *March,* 1940.—A cylindrical condenser has been so designed that it may be filled to a variable height with a liquid whose dielectric constant is desired. From the variation of the capacitance with the height, and a knowledge of the dimensions of the cylinders, one can make a determination of the constant that is free from errors due to stray capacitances. An analysis of the apparatus seems to indicate that the method is capable of high precision. Authors.

1635. Dielectric constants of pairs of diastereomers. S. Winstein and R. E. Wood. *Am. Chem. Soc., J.,* **62,** *pp.* 548–551, *March,* 1940.—The dielectric constants of 7 pairs of diastereomers, namely, the 2,3-diacetoxybutanes, 2,3-diacetoxypentanes, 3,4-diacetoxyheptanes, 2,3-dibromobutanes, 2,3-dibromopentanes, 3,4-dibromohexanes and 2-acetoxy-3-bromobutanes, have been measured. In general, the members of a pair of diastereomers differ sufficiently in the dielectric constants for the dielectric constant to be useful for analytical purposes. From these dielectric constants dipole moments have been estimated using Onsager's equation. The ϵ's and μ's for *meso* and *erythro* compounds are compared with those for the corresponding *dl* and *threo* isomers. Authors.

1636. Dielectric capacity of electrolytes in mixed solvents on association in solutions of $MgSO_4$. W. A. Mason and W. J. Shutt. *Roy. Soc., Proc. A,* **175,** *pp.* 234–253, *April* 10, 1940.—The orientation (saturation) of solvent dipoles around ionic charges and the phenomena of ion association are considered in relation to their bearings upon the dielectric constants of solutions of electrolytes. A modified " force " method for the determination, at low frequency, of the dielectric constants of conducting liquids is described. Figures are given for the dielectric constants of dioxan-water mixtures (from 0 to 75% dioxan) and of aqueous solutions of urea (to 9*M* urea). The dielectric constants of solutions of $MgSO_4$ in these aqueous solvents have been determined. The Bjerrum association constants (K_a) and the Sack saturation constants (k) have been calculated from the results. The variation of K_a and k, with dielectric constant of solvent, is discussed. Authors.

1637. Dielectric constant, power factor, and resistivity of marble. A. H. Scott. *Bureau of Standards, J. of Research,* **24,** *pp.* 235–240, *March,* 1940.—The dielectric constant, power factor, and resistivity of marble from Vermont, Alabama, and Georgia were determined when the marble was dry and after it had been stored for over a month in an atmosphere having a relative humidity of 85%. The effect of frequency on the dielectric constant and power factor was also studied. The results are presented in the form of tables. It was found that the electrical properties of marble may vary widely but that the coloured marbles have higher dielectric constants and power factors than the white marbles. Author.

1638. Dielectric constant of diamond. L. G. Groves and A. E. Martin. *Faraday Soc., Trans.,* **36,** *pp.* 575–581, *April,* 1940.—The dielectric constant of diamond has been determined by two methods: (1) involving solid-air capacity changes and employing a micrometer cell of variable capacity with the diamond sandwiched between the electrodes; (2) involving solid-liquid capacity changes and employing a micro cell of fixed air capacity, with constant boundary conditions irrespective of the nature of the replaceable dielectric medium. The capacity changes have been measured by direct compensation with a micrometer variable condenser in the tuned circuit of one oscillator of a heterodyne apparatus, the condenser readings being estimated to 2×10^{-4} $\mu\mu$F. The accuracy of the second method has been checked by an independent determination of the dielectric constant of chlorobenzene at 25°C. The values of the dielectric constant of diamond obtained by the two methods are 5·26 and 5·35 respectively, the latter being the preferred figure. No difference has been observed between the dielectric constants of the two types of diamond discussed by Robertson, Fox and Martin. AUTHORS.

See also Abstract 1337 and

714B. Molecular nature of a dielectric. E. B. Moullin.
726B. Inductance and damping of wound condensers. E. Leider.

ELECTROCHEMISTRY.

1639. Electrolytic formation of periodates. A. HICKLING AND S. H. RICHARDS. *Chem. Soc., J., pp.* 256–264, *March,* 1940.—The electrolytic oxidation of iodates to periodates and the effect of variable factors such as the nature of the electrode material, acidity and alkalinity, temperature, anode potential, and the presence of foreign anions have been investigated. The process takes place with moderate efficiency at PbO_2 and Ni electrodes, to a less extent at platinized and smooth Pt, and with MnO_2 and C anodes no appreciable oxidation occurs. The efficiency is least in acid and greatest in alkaline solutions. At Pt and PbO_2 electrodes factors favouring the formation of higher oxides on the electrode, e.g., anodic prepolarization, in general increase the efficiency markedly. Rise of temperature leads usually to an improvement in efficiency except in the case of a smooth Pt anode in alkaline solution. The anode potentials set up during the oxidation appear to be merely O_2 evolution values and no indication of a definite oxidation-reduction potential is found. Various mechanisms for the anodic process are considered, and it is concluded that the facts can best be explained by oxidation of the iodate by metallic peroxides formed on the electrode surface, a secondary rôle being attributed to H_2O_2 formed initially in the discharge of OH ions, and this explanation is supported by independent chemical experiments. [See Abstract 3775 [1939].) AUTHORS.

1640. Temperature dependence of dissociation constant of deuteroacetic acid. F. BRESCIA, V. K. LAMER AND F. C. NACHOD. *Am. Chem. Soc., J.,* **62**, *pp.* 614–617, *March,* 1940.—The equivalent conductances of sodium chloride, sodium acetate, hydrochloric acid, and acetic acid have been measured at 14·36, 25, 35 and 44·86° in a solvent whose D fraction is 0·925. From these data, the dissociation constant of deuteroacetic acid at $F_D = 1$ is calculated at corresponding temperatures. The dissociation constant of deuteroacetic acid follows the Harned-Embree equation and passes through a maximum at 31°; protoacetic acid at 22°. The ratio K_H/K_D decreases with increasing temperature. The differences in the heats, free energies and entropies of ionization of the deutero and proto acids have been calculated. ΔC_p for the exchange process $HOAc(H_2O) + D^+(D_2O) + OAc^-(D_2O) = DOAc(D_2O) + H^+(H_2O) + OAc^-(H_2O)$ is sensibly zero; ΔS is sensibly constant and equal to $-1{\cdot}3$ cal. deg.$^{-1}$ mole^{-1}. [See following Abstract.]. AUTHORS.

1641. Electrostatic effects on ionization constants. V. K. LAMER AND F. BRESCIA. *Am. Chem. Soc., J.,* **62**, *pp.* 617–620, *March,* 1940.—The equation $\Delta H_r = \Delta H_s + c1/D_r\,[1 + T\,\partial \ln D/\partial T]$, represents with high precision ΔH, the heat of dissociation of deuteroacetic acid as a function of temperature, when $\Delta H_s = 2\,260$, and $c = 4{\cdot}410 \times 10^{+5}$. The values for protoacetic acid are 2 030 cal. and $4{\cdot}714 \times 10^{+5}$, corresponding to (Born) r values of 0·75 and 0·70 Å, respectively. ΔC_p for an acid-base exchange reaction involving D and H in D_2O and in H_2O is practically zero since the radii of the ions and the dielectric properties of the two media are practically identical. The difference in the heats of ionization of deutero and proto acids appears to be a function only of the characteristic temperature Θ at which the maximum value of the dissociation constants occurs. The desirability of determining the temperature coefficients of dissociation constants of acids, not only in solvents of constant composition but also in solvents of constant dielectric constant, is pointed out. The empirical constant $p \cong 4{\cdot}5 \times 10^{-5}$ in the Harned-Embree equation is shown on theoretical grounds to be equal to $p = \epsilon^2/(2{\cdot}3R)rD^3)\cdot(\partial D/\partial T)^2\cdot(1/2\Theta)$.[See also Abstract 4666 (1939) and preceding Abstract.] AUTHORS.

1642. Second ionization constant and related thermodynamic quantities for malonic acid from 0° to 60°C. W. J. HAMER, J. O. BURTON AND S. F. ACREE. *Bureau of Standards, J. of Research*, **24**, *pp*. 269–292, *March*, 1940.—The second ionization constant of malonic acid in aqueous solution was determined at 0° to 60°C. from measurements of the e.m.f. of galvanic cells without liquid junction. Solutions containing sodium acid malonate, sodium malonate, and NaCl were employed for these determinations. From the values of the ionization constants, the closest distance of approach, or the so-called diameters, of the ions in the solution was calculated for the different temperatures. These ionic diameters, the e.m.f. and the known molalities were then employed to calculate pH values of the solutions. The ionization constant at the different temperatures was determinted from the experimental data by three different methods, using a least-square calculation in each. The values are different for the various temperatures, and may be computed for temperatures from 0° to 60°C., inclusive, by the equation:

$$\log K_2 = 1053{\cdot}08/T + 20{\cdot}3223 \log T - 0{\cdot}05838T + 0{\cdot}0000236\,T^2 - 37{\cdot}1402$$

Equations were formulated to express the variation of pH as a function of the ionic strength of the solution, to give the heat of ionization of the acid malonate ion, and to give the difference in the specific heats of the ions and the undissociated acid malonate ion at each temperature. The change in free energy and entropy for the ionization of the acid malonate ion were also calculated for each temperature. All of these quantities are of importance in arriving at explanations for the variation of H-ion activity with temperature. AUTHORS.

1643. Periodic variations of tin potential in CrO_3-HCl solutions. G. EHRENSVÄRD, M. KARSCHULIN AND I. EHRENSVÄRD. *Arkiv f. Kem. Min. och Geologi, Stockholm, A*, **13**, 20, *pp*. 1–11, 1939. *In German*.—The investigation, described in Part I [see Abstract 822 (1939)], was continued. The frequency scheme for the periodic variation of potential of tin in solutions of CrO_3 — HCl was determined, and three typical forms were observed. The first was a type of slow variation in the negative potential section measured against the H_2 electrode. The second was a slow variation in the positive range of potential variation. The periodic variations on the third range were of a high frequency, not previously observed in such a system. The frequency was of the order of 250 c./s. F. J. B.

1644. Electrode potential of crystal surfaces of metals. Part I. Preliminary experiment on Zn. M. SATÔ AND K. MARUYAMA. *Tohoku Univ., Sci. Reports,* **28,** *pp.* 386–397, *Feb.,* 1940. *Report No.* 466 *of the Research Inst. for Iron, Steel and Other Metals.*—For Zn polycrystal electrodes prepared by special methods, the authors measured the normal potential of the surfaces, (0001), $(10\bar{1}0)$ and $(11\bar{2}1)$, with HCl-solution at 25°, obtaining the values: (0001), 870; $(10\bar{1}0)$, 851; $(11\bar{2}1)$, 809 mV., the standard being the normal H_2 electrode at 25°. These values are in agreement with respective values obtained by H_2SO_4-solution, the latter having been already determined from the data by Straumanis. AUTHORS.

1645. Chemical action upon metals. V. KARPEN. *Comptes Rendus,* **210,** *pp.* 371–374, *March* 4, 1940.—The expression, given in a former paper [see Abstract 235 (1940)], for the p.d. between a metal and the electrolyte in which it is immersed, and the considerations which led to it, have enabled data to be obtained with respect to the chemical attack of metals by acids and analogous substances. It is shown by a detailed argument that the attack of a metal is determined by the absence of statistical equilibrium between kations and electrons of the metal and those of the solution. It is further shown that the same considerations apply to the attack of metals by halogens or O_2, and also how Cu is attacked by H_2SO_4 in the cold when O_2 under pressure is introduced into the solution. H. H. HO.

See also Abstracts

710B. Action of voltaic apparatus. A. Reiffer.
711B. Organic electrolysis. A. L. Jaques.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

1646. General relation between e and h. J. FUCHS. *Ann. d. Physik,* **36,** 7, *pp.* 621–624, *Dec.,* 1939.—Starting from the usual relation connecting h Planck's constant, e the charge on the electron, and the orbital velocity v in the K-shell of the H atom, the author deduces the relation $h = e^2 Z_H/2$, where Z_H is taken to be the wave resistance of the region comprising the H atom. It is claimed that this expression is noteworthy in that it connects a fundamental corpuscular magnitude e and a clearly electromagnetic quantity Z_H by means of the quantum of action h. G. O. B.

1647. Radius of electron and calculation of photoelectric constant of metals. T. IONESCU. *Comptes Rendus,* **210,** *pp.* 170–172, *Jan.* 29, 1940.—In an attempt to test experimentally the validity of the formula $\rho = h/2\pi mv$ for the radius of the electron, the author assumes that the electrons moving in a cubic crystal have a diameter equal to the length of the cube side less the diameter of the metallic ions forming the lattice. On this assumption the velocity of the electrons is calculated from the formula, for 9 metals, taking accepted values for the atomic and lattice dimensions. The agreement of the velocity so obtained, in volts, with the photoelectric potential is good. G. O. B.

1648. Determination of masses and velocities of 3 RaB β-Particles. Relativistic mass of electron. M. M. ROGERS, A. W. MCREYNOLDS AND F. T. ROGERS, JR. *Phys. Rev.,* **57,** *pp.* 379–383, *March* 1, 1940.—An accurate determination of the values of m/e and v of the three RaB β-particles was made by means of an electrostatic spectrograph. It is shown that these particles obey the Lorentz model for electrons rather than the Abraham model, for velocities as high as 0·75 of the velocity of light. The uncertainty in the experiment is less than one-tenth the magnitude of the difference between the two models. AUTHORS.

V.4
194

1649. Relativistic magnetic moment of a charged particle. H. Margenau. *Phys. Rev.*, **57**, *pp.* 383–386, *March*, 1, 1940.—Formulae are derived for the magnetic moment of a particle moving rapidly in a central field of force. Possible nuclear applications, particularly to the problem of the deuteron, are discussed. In view of the greatly increased accuracy in the measurement of magnetic moments, the relativity effect appears to be of measurable magnitude. Author.

1650. Magnetic resonance for non-rotating fields. F. Bloch and A. Siegert. *Phys. Rev.*, **57**, *pp.* 522–527, *March* 15, 1940.—A treatment of the magnetic resonance is given for a particle with spin $\frac{1}{2}$ in a constant field H_0 and under the action of an arbitrary alternating field with circular frequency ω perpendicular to H_0. A method of finding a solution, valid at any time, is given which converges the better the smaller the deviations from a rotating field or the larger H_0. It is shown that in the lowest order correction the shape of the resonance curve is unchanged but that it is shifted by a percentage amount $H_1^2/16\ H_0^2$ where H_1 is the effective amplitude of the oscillating field. This also involves a correction in the values of the magnetic moments thus obtained towards smaller values which however in all practical cases is negligibly small. Authors.

1651. Scattering of slow neutrons by protons. M. S. Plesset and F. W. Brown. *Nat. Acad. Sci., Proc.*, **25**, *pp.* 600–604, *Dec.*, 1939.—The cross-sections and energy levels for the scattering of slow neutrons by protons are calculated by the spherical well potential and on the meson field theory. Calculations for the potential hole show that the assumption frequently made of negligible interaction width leads to appreciable inaccuracies. The introduction of the virtual level of the deuteron to describe singlet scattering is considered; the sequence of virtual levels as defined by the Kapur-Peierls scattering procedure is determined in order to illustrate the convergence of the results obtained by the different methods in the extreme case of the deuteron. J. E. K.

1652. Proton-proton scattering. K. C. Kar and D. Basu. *Phil. Mag.*, **29**, *pp.* 200–204, *Feb.*, 1940.—Calculations on proton-proton scattering are made by means of perturbation theory. R. P.

1653. Scattering and polarization of electrons. M. E. Rose. *Phys. Rev.*, **57**, *pp.* 280–288, *Feb.* 15, 1940.—The possibility of accounting for small polarization of electrons, as observed in double scattering experiments, and the anomalously small scattering of fast electrons in heavy scattering materials, by the assumption of non-Coulombian forces near the nucleus is investigated. It is assumed that the range of the anomalous forces is of the order of the nuclear (or electron) radius so that the scattering of only $s_{1/2}$ and $p_{1/2}$ electrons is considered. Results for the scattering and asymmetry, at 90° in Au, when only the $s_{1/2}$ or $p_{1/2}$ wave is scattered are discussed in detail with reference to observation and show that to obtain an asymmetry and scattering which are not in complete disagreement with observations it is necessary to assume either a large range or a specialized form for the non-Coulombian forces. The specialized form involves certain theoretically unsatisfactory consequences. Alternatively the anomalous scattering and asymmetry must be explained on grounds other than the existence of non-Coulombian forces. N. M. B.

1654. Excitation of nuclei by fast electrons. G. C. Wick. *Ricerca Scientifica*, **11**, *pp.* 49–57, *Jan.–Feb.*, 1940.—By means of Dirac's theory the cross-sections for the excitation of nuclei by electrons of relativistic energy are calculated. Dipole, quadrupole, and magnetic dipole transitions are considered. Accurate evaluation of the results is not yet possible, however, owing to our lack of information concerning the actual magnitude of the dipoles, etc. involved. L. E. F.

1655. Formation and maintenance of electrons and ion beams. L. P. Smith and P. L. Hartman. *J. of Applied Physics*, **11**, *pp.* 220–229, *March*, 1940.—The radial potential distribution in an ionic beam of circular cross-section is calculated and the maximum beam current which can be obtained in a beam of given radius and boundary conditions is computed. In the case of ions the maximum beam currents may be quite small. The ions in such beams have a considerable velocity distribution which in turn leads to a greater beam divergence than former calculations indicate. A method is worked out for holding the beam together during the initial accelerations. A disadvantage of cylindrical lenses is pointed out in this connection. The use of electrostatic lenses for holding together a beam composed of high energy particles is discussed in some detail. Calculations show the special arrangements of the lenses necessary for producing convergence of the beam. A few other arrangements which were tried experimentally to prevent divergence are described. Authors.

***1656. Unique oscillographic demonstrations.** F. E. Hoecker and A. G. Asher. *Am. J. Phys.*, **8**, *pp.* 59–62, *Feb.*, 1940.—The limitations of the cathode-ray oscillograph are overcome by the apparatus described, which has a range extending to include extremely slow and non-recurrent phenomena. A luminescent tracing is produced on a mechanically driven celluloid screen coated with phosphorescent ZnS by a light beam from the galvanometer mirror. Illustrations of the scope of the instrument in electromagnetic induction experiments, action of a condenser, and biophysical phenomena are given. N. M. B.

See also Abstracts 1414, 1415, 1525, 1526, 1626.

ELECTROSTATICS.

See Abstracts 1601, 1641, 1645.

MAGNETISM AND ELECTROMAGNETISM.

1657. Approach to saturation of magnetization of Ni and temperature dependence of the anisotropy constant. H. Polley. *Ann. d. Physik*, **36**, 7, *pp.* 625–650, *Dec.*, 1939.—The differential susceptibility dI/dH of polycrystalline Ni was measured as a function of H up to 3 000 gauss, and between -253°C. and 135°C. the approach to saturation could be represented by $dI/dH = AH^{-3} + BH^{-2} + C$, where A, B and C are temperature dependent. The anisotropy constant K was deduced from A by means of the theory of pure rotation processes, and agreed well with single crystal determinations; it was found to increase strongly with falling temperature. The origin of the term BH^{-2} is discussed, and the term C varies with temperature in accordance with the Langevin-Weiss theory, but is 10 times larger than expected. D. S.

1658. Statistical domain theory of ferromagnetic crystals. M. Takagi. *Tohoku Univ., Sci. Reports*, **28**, *pp.* 20–127, *Oct.*, 1939. *Report No.* 459 *of the Research Inst. for Iron, Steel and Other Metals.*—The domain theory of Honda and Okubo [see Abstract 1287 (1916)] is generalized and statistically treated in such a way that it becomes unnecessary to distinguish between inversion and rotation processes of magnetization. The usual methods of minimizing the energy for the rotation process and Heisenberg's statistical treatment for the inversion process are both included in the theory as special cases. Part I deals with magnetization and magnetostriction of unstressed cubic and hexagonal crystals, while the effects of stresses and the change of mechanical properties with magnetization are discussed in Part II. A feature of the theory is that for many magnetic phenomena a single mathematical expression is deduced both for weak and strong fields, and new relations between some magnetic quantities are derived. D. S.

1659. Ferromagnetic domains and the magnetization curve. W. F. Brown, Jr. *J. of Applied Physics,* **11,** *pp.* 160–172, *March,* 1940.—The magnetization curve and hysteresis loop of a ferromagnetic material used to be explained qualitatively through the interaction of " molecular magnets". It is now known that interaction of the atoms produces, directly, only magnetic saturation, and that the " magnets " whose interaction is responsible for the details of the hysteresis curve are much larger things—magnetically saturated regions big enough to be seen under a microscope. These " spontaneously " magnetized regions are known as " domains", and with them progress is being made toward a quantitative theory of the magnetization process. The basic ideas of the domain theory are described in this article. Author.

1660. Magnetic moment of ferromagnetic alloys. Part II. Gyromagnetic phenomenon. Supplementary moments and Curie points. R. Forrer. *J. de Physique et le Radium,* **1,** *pp.* 74–80, *Feb.,* 1940.—According to Part I of this study [see Abstract 3024 (1939)] the elementary moment of the ferromagnetic alloys Fe, Co, Ni, is decomposed into two moments of different nature, the moment of the base due to the spin, and the supplementary moment, orbital in character. Consequently the upper limit of gyromagnetic phenomena can be calculated and the experimental values compared. The conception of a coupling of spin orbital behaviour gives meaning to Weiss's empirical law of approach to saturation. On the other hand in the arrangement of the face-centred cube in which the number of neighbours at short distance is large, the Curie point depends on the supplementary moment and is independent of the moment of spin. The Curie point θ is given by the number N and the intensity F of the electronic interactions : $\theta = F\sqrt{N}$. The number of the interactions is limited on the one hand by the magnitude of the supplementary moment if the number of neighbours at efficacious distance is great, and is limited on the other hand by this number of neighbours if the supplementary moment is great. J. J. S.

1661. Paramagnetic relaxation times for Ti and Cr alum. J. H. van Vleck. *Phys. Rev.,* **57,** *pp.* 426–447, *March* 1, 1940.—The relaxation times for spin-lattice coupling in Ti and Cr alums are computed on the basis of a specific model obtained by combining the thermodynamic theory of Casimir and du Pré with the writer's previous treatment of the normal modes of a cluster of the form $X \cdot 6H_2O$, where X contains an incomplete shell. The calculation includes both the first-order or direct processes important at low temperatures, and the second-order or " Raman " type of term predominant in the liquid-air region. There is no difficulty in understanding the observed absence of dispersion in Ti alum at liquid-air temperatures, but, barring crystal imperfections, it is hard to understand this absence at He temperatures unless the nearest excited states are unreasonably deep. The agreement between the orders of magnitude of the calculated and experimental relaxation times is adequate in Cr both at high and low temperatures. The calculations predict, in agreement with experiments, that at liquid-air temperatures the relaxation time should increase when a constant field H_0 is applied and should be independent of the direction of H_0. The computed increase, however, is apparently not great enough. At He temperatures, τ is theoretically not quite isotropic, and $d\tau/dH_0$ has the wrong sign, unless one abandons the usual formula $\rho_\omega \sim \omega^2$ for the density of lattice oscillators. The calculations on Cr should apply qualitatively to Fe alum, as discussed at the end of the paper. AUTHOR.

1662. Heterogeneous O-p-conversion on paramagnetic crystals. L. FARKAS AND L. SANDLER. *J. Chem. Phys.*, **8,** *pp.* 248–251, *March*, 1940.—The rate of conversion of *p*-H_2 and of *o*-D_2 is measured on paramagnetic crystals, viz. $CuSO_4$, $NiCl_2$ and neodymium oxalate. In the last case, crystals of approximately uniform size were used so that the total converting area was known. The conversion rate has a maximum at 0°C. and it is shown that below this temperature the desorption rate of the H_2 and the D_2 is rate-determining. Hence, the ratio of the rates for H_2 and D_2 is not far from unity. The rate of desorption increases with increasing temperature and at higher temperatures, the rate of conversion on the surface becomes the slow process. The ratio of the rates for H_2 and D_2 becomes nearly 11 in this region. The heat of adsorption of the hydrogen on neodymium oxalate is about 2·4 kg.cal./mole. AUTHORS.

1663. Laws of electromagnetic induction. W. V. HOUSTON. *Am. Phys. Teacher*, **7,** *pp.* 373–378, *Dec.*, 1939.—Understanding of the fundamental principles of electromagnetism is rendered more difficult by the inadequacy of the usual simplified formulations. The law of electromagnetic induction is often stated in two parts, one stating that the e.m.f. is proportional to the rate of change of the total induction through the circuit, the other stating that the e.m.f. induced in a conductor cutting lines of magnetic induction is proportional to the rate at which these lines are cut. The author indicates the errors that may arise from the visualization of the process resulting from the second statement. A general formulation of the law, including both parts and applicable to any case, can be established by recognizing that electric and magnetic fields depend not only on the point in space and instant in time to which they refer but also on the system of co-ordinate axes to which they are referred. The transformation of fields from one system of axes to another can be effected approximately by elementary means. The concept of a field that depends on the system of coordinate axes with reference to which it is expressed is a precise concept and one that is fundamental in much of electromagnetic theory. The author considers a number of experimental arrangements and points out the advantage of using the method of transformation of fields in preference to the more customary treatments. R. E. N.

See also Abstracts 1375, 1376, 1532, 1650, and
751B. Self-induction. A. O'Rahilly.
752B. Measurement of constant magnetic fields. Part I. H. Neumann.
754B. Physical basis of ferromagnetism. R. M. Bozorth.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1664. Miniature X-ray chest films. H. E. POTTER, B. H. DOUGLAS AND C. C. BIRKELO. *Radiology*, **34,** *pp.* 283–291, *March*, 1940.—Experience indicates that the 4 × 5 inch photoroentgenograph is quite accurate. Only 2·6% error occurred in detecting 271 cases with active tuberculous lesions as found in the full size film taken of 1 610 persons. This type of examina-

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194

tion can be applied in survey work in tuberculosis to large numbers rapidly and economically. (Slightly faster than 1 per min. at a material reduction in cost.) It has definite advantages over certain other X-ray methods of examination either in accuracy or in cost or both. This method of examination can be applied directly without preliminary tuberculin testing with greater accuracy and at the same time economically. Finally, the authors believe photoroentgenography of this type offers a practical method for case finding in tuberculosis for use in surveying large numbers in susceptible groups. AUTHORS.

***1665. Clinical dosemeters.** C. E. EDDY. *Brit. J. of Radiology,* **13,** *pp.* 130–135, *April,* 1940.—The importance of determining X-ray and γ-ray dosages delivered to the skin and normal and tumour tissues is being greatly appreciated in modern radiotherapy. Frequently, X-ray dosage calculations are derived from measurements made on the X-ray beams in hospitals using some form of clinical dosemeter. The performance and accuracy of these instruments is discussed. It is considered that regularly calibrated clinical dosemeters can be used to measure free air dosage rates and X-ray quality with the requisite accuracy. The errors which may arise through the use of dosemeters for the direct determination of skin and depth doses are discussed. The use of large ionization chambers with dosemeters enabling dosage rates of the order of the tolerance dose to be determined, is suggested as a valuable means of checking protection measures. AUTHOR.

1666. Radiation from a l.v. X-ray tube (cautery technique). L. F. LAMERTON. *Brit. J. of Radiology,* **13,** *pp.* 136–146, *April,* 1940.—A study has been made of the physical properties of the radiation produced at 44 kV by the "Metalix" therapy apparatus. Absorption measurements in Al, water, and certain other solutions are described. The first half-value layer of the unfiltered radiation is found to be 0·30 mm. Al, corresponding to an equivalent wavelength of 840 X.U. Central axis depth-dose curves for the unfiltered and filtered radiation at various focal-skin distances are given, together with some complete isodose curves. A condenser chamber for the measurement of the dosage-rate in air which may be used with standard Victoreen condenser dosemeter is described. A surface dosage rate of 7 610 r./min. is obtained with the unfiltered radiation at the shortest focal-skin distance (2·0 cm.), but the penetration is very small, 4 mm. of water being sufficient to reduce the dosage-rate to one half of its surface value. Owing to the heavy absorption of the water the amount of scattered radiation outside the geometrical edge of the beam is small. Measurements of the stray radiation around the tube are described. The results of other workers are discussed, and, finally, a description is given of an attempt to determine the energy distribution in the spectrum of the radiation by an analysis of the absorption curve in Al. AUTHOR.

1667. Measurement, in roentgens, of the γ-radiation from Ra by the free-air ionization chamber. L. S. TAYLOR AND G. SINGER. *Bureau of Standards, J. of Research,* **24,** *pp.* 247–268, *March,* 1940.—The free-air ionization chamber is the accepted standard for calibrating X-ray dosage measuring instruments. With the advent of supervoltage X-rays, the need for proven standards for this range has arisen. The present paper describes an investigation of the applicability of the free-air pressure ionization chamber for measuring radiation at the h.f. end of the X-ray spectrum, that of the γ-radiation from Ra. Measurements were made with a narrow collimated beam of γ-rays at pressures up to 10 atm. Because of inability to obtain full current-voltage saturation, application was made of the extrapolation of reciprocal current-voltage curves in accordance with the Joffe-Zanstra theory. This was first tested carefully with 350-kV X-rays at 1-, 6-, and 10-atm. pressure and found to hold within the experimental limits. It was found that at 10-atm. pressure a plate separation of about 35 cm. is necessary to utilize the full electrical range. Ranges in the forward direction were not effectively greater than 70 cm. Measurements of the γ-ray emission from Ra gave a value of 8·16 roentgens per mg./hr. at a distance of 1 cm., which is in line with several similar determinations by other methods. AUTHORS.

1668. Protection in radium teletherapy at Westminster Hospital. C. W. WILSON. *Brit. J. of Radiology*, **13**, *pp.* 105–107, *March*, 1940.—Sievert-type condenser ionization chambers have been used for measuring the stray radiation received by operators in the course of their duties which consist in applying the Ra beam unit treatment to patients. The Sievert chambers were constructed of electron metal 1 mm. thick, 6 cm. long and 1 cm. dia., with amberoid insulation, and they had a sensitivity of 500 V/r. (on the basis that 1 mg./hr. at 1 cm. = 8 r.). Using the 2 gm. unit with 5 cm. Pb protection an average daily dose of 0·24 r. was received. Using the 4 gm. unit with a container of W alloy 5 cm. thick equivalent to 7·5 cm. of Pb [see Abstract 1342 (1938)] the protection afforded by the containers was such that the tolerance dosage rate of 10^{-5} r./sec. existed at 2 m. from the units when they were directed vertically downwards; the average measured daily dose was then 0·18 r. When, however, the 4 gm. unit and the 2 gm. unit were used together in the same room, it was necessary to apply stringent rules for the safe use of the units, to arrange that the Ra containers when not in use were lowered into a Pb well 5 cm. thick and to employ a system of remote control. It was then found possible to reduce the average dose received by the operators below the recognized tolerance of 0·25 r. per diem to 0·13. None of the personnel has had any illness which could be attributed directly to the effects of radiation. T. A. C.

***1669. Model head and dose finder.** F. W. SPIERS. *Brit. J. of Radiology*, **13**, *pp.* 147–148, *April*, 1940.—A dose finder is described for use in conjunction with a transparent model head. Points inside the head are located by means of two light beams, and dose estimations are then made with an isodose chart which can rotate about its principal axis. AUTHOR.

See also Abstract 1593 and

790B. Electrical function of nervous tissue. H. Beau and H. Fischgold.

OSCILLATIONS AND WAVES.

1670. Earth magnetic changes and Dellinger's effects of radio waves. M. HIRAYAMA. *Geophys. Mag., Tokyo*, **13**, *pp.* 117–135, *Dec.*, 1939.—After an analysis of the statistics of radio fade-outs observed in Japan during 1935–6, and of simultaneous magnetic disturbances, a theoretical discussion of the magnetic effects produced by a sudden change in the ionization of the ionosphere is pursued. It is concluded that if the disturbed region in the ionosphere subtends at a point on the earth's surface below its centre a semi-vertical angle greater than 10°, the magnetic effects at the point are practically the same as if the whole ionosphere were disturbed. It also follows that if a restricted disturbed region passes over a point on the earth's surface, a sudden change of conditions will occur as the boundary of the region passes over the point. Observations appear to indicate that the disturbed regions are too small to be accounted for by sunspots, and are more probably due to chromospheric eruptions. The time interval between radio fade-out and magnetic disturbance depends on the conductivity of the ionosphere. The bearing of these results on the interpretation of observations, and the effects of atmospheric tides is briefly discussed. J. P. A.

1671. Reflection and absorption of radio waves in the ionosphere. K. B. MATHUR. *Nat. Inst. Sci., India, Proc.*, **5**, 2, *pp*. 167–183, 1939. —Curves showing variation of refractive index and absorption coefficient with height have been drawn for different frequencies for a simple layer, in the quasi-transverse and quasi-longitudinal cases. Assuming that the reflection takes place where the variation of refractive index with height is very large, the points where reflection takes place and the corresponding total integrated absorption coefficients have been calculated. It has been shown that the reflection corresponding to the condition $\mu = \infty$ is not possible. The extraordinary ray is shown to be more absorbed than the ordinary ray in all cases, except in the quasi-transverse case for frequencies greater than the gyromagnetic frequency where the reverse is the case. In the non-deviating region the extraordinary ray is less absorbed than the ordinary ray. AUTHOR.

1672. Absorption of radio waves in the earth's atmosphere. R. R. BAJPAI AND K. B. MATHUR. *Nat. Inst. Sci., India, Proc.*, **5**, 3, *pp*. 325–344, 1939.—In this mathematical paper, magneto-ionic theory is developed along familiar lines, and a clear distinction is made between the special types of propagation termed (1) quasi-transverse and (2) quasi-longitudinal, which are defined by the condition that $[2(r - \beta)\omega_z/\omega_x]^2$ is much less or much greater than 1; $r = p_0^2/p^2$; $\omega_{x,z} = p_{h(x,z)}/p$; p_h is the Larmor frequency, p the pulsatance of the waves. Making simple assumptions regarding the variation of electron density and collision frequency with height, the following special cases are analysed, viz.: A. Both magneto-ionic components are governed by (1). B. The extraordinary wave is governed by (2) and the ordinary by (1). C. Both waves are governed by (1). These cases are found to be applicable to different magnetic latitudes. The question of absorption is then investigated, firstly in the non-reflecting region of the ionosphere, away from, and then near the magnetic equator; and secondly for the reflecting regions, for equatorial, intermediate, and high latitudes. The different absorptions for O and E rays are discussed. J. P. A.

1673. Absorption and reflection of radio waves at oblique incidence and their relationship with vertical incidence phenomena. K. B. MATHUR. *Nat. Inst. Sci., India, Proc.*, **5**, 3, *pp*. 345–357, 1939.—It is extremely useful to obtain data for long-distance transmission of electromagnetic waves through the ionosphere from observations made at vertical incidence. Martyn first showed that the absorption for oblique propagation is simply related to that observed at vertical incidence with the three simplifying assumptions: (*i*) that the gradient of electron density is everywhere vertical and similar throughout the path of the ray, (*ii*) that the earth's magnetic field can be neglected, and (*iii*) that the earth is flat. Smith further showed that the maximum usable frequency for oblique propagation could also be derived from the characteristics of $(P' - f)$ curves obtained at vertical incidence under the same assumptions as those of Martyn. Millington [see Abstract 4261 (1938)] developed the above theorems for a curved earth and showed them to hold for a relatively thin layer. Millington's work has been further modified by Smith to allow for a thick layer assuming linear distribution of electron density, but he has only derived an expression for equivalent frequency. In the present paper, starting from Smith's theorems [see Abstract 2031B (1938)], relations have been deduced both for equivalent frequency as well as for absorption for the cases of linear and exponential gradient of electron density. AUTHOR.

1674. Theory of reflection of very long radio waves from the ionosphere. M. V. WILKES. *Roy. Soc., Proc. A*, **175**, *pp.* 143–163, *April* 10, 1940.—This paper is concerned with the theoretical interpretation of the experimental data already published [see Abstract 2655 (1939)] on the reflected wave received via the ionosphere at short distances (about 90 km.) from the British Post Office transmitter at Rugby (wavelength 18 800 m., 16 kc./sec.). It is shown that the diurnal changes in reflection height are in agreement with what would be expected if reflection took place from the bottom of a region of the type described by Chapman, in which the ionization is in quasi-equilibrium with the changes in zenith angle of the sun. The polarization and amplitude of the wave reflected from a layer of ionized gas in a magnetic field when a plane polarized wave of wavelength comparable with the dimensions of the layer is incident on it are discussed, and in particular the type of wave reflected from a Chapman region is deduced. It is shown that the observed constancy of the amplitude of the downcoming wave until near the end of the sunset period leads to the conclusion that in the reflecting region the frequency of electronic collisions is not greater than about 2×10^6 per sec., and the possibility of collisional absorption taking place below the reflecting level is discussed. The question of whether or not the " Lorentz term " is to be included in the magneto-ionic equations is considered, and it is shown that the long-wave evidence, though not conclusive, appears to be against including it. AUTHOR.

See also Abstracts 1540, 1625, 1633.

PHOTO-ELECTRICITY.

1675. Photo-electric and optical properties of Na and Ba. R. J. MAURER. *Phys. Rev.*, **57**, *pp.* 653–658, *April* 1, 1940.—Experimental spectral distribution curves have been obtained for Na and Ba using polarized and unpolarized radiation. The work function of Na was determined as 2·28 eV and that of Ba as 2·48 eV. The experimental data are compared with the theory of Mitchell [see Abstract 2438 (1936)]. The theory fails to account satisfactorily for the absolute photo-electric yields and for the ratio of the photo-electric yields obtained with radiation polarized parallel and perpendicular to the plane of incidence. AUTHOR.

1676. Photo-electric effect of metals at high temperature. M. DELLA CORTE. *Ricerca Scientifica*, **10**, *pp.* 1096–1098, *Dec.*, 1939.—Comparison of the characteristic curves of a diode taken when the cathode (a W filament at 2 100°) was irradiated with infra-red and with visible light, show that visible light gives rise to an appreciable number of photo-electrons, although at room temperature the photo-electric threshold of W is 2 660 Å. The effect is in qualitative agreement with theoretical considerations of Fowler. L. E. F.

***1677. Characteristics of 3-electrode photocells.** T. FRANZINI. *Ricerca Scientifica*, **10**, *pp.* 1025–1030, *Nov.*, 1939.—Describes the construction of 3-electrode photocells of various types, viz., Na, K, Rb and KH, both solid and thin film, *in vacuo* and with a gas filling, H_2 or He. The relation between the current for a given illumination and the voltage applied to the grid is given for certain types of cells. J. W. T. W.

1678. Photovoltaic cells with Ag-AgBr electrodes. Part III. Optical sensitizing by dyes. S. E. SHEPPARD, W. VANSELOW AND G. P. HAPP. *Kodak Research Lab., Comm. No.* 742. *J. Phys. Chem.*, **44,** *pp.* 411–421, *April*, 1940.—An investigation has been made of the effect of an optically sensitizing (cyanine) dye on the photovoltaic effect with Ag-AgBr electrodes. It was established that definite optical sensitizing of the primary negative, or photoelectronic, effect was effected. Light absorbed by the adsorbed dye,—and which is not absorbed by AgBr itself—produced relatively large (electronic) photocurrents. At the same time, it was shown that the adsorbed dye acts as a halogen acceptor, diminishing the (reverse) positive effect, and this function occurs whether the active radiation is that absorbed by AgBr or by the dye. The results are in excellent agreement with those obtained in the study of the photolysis of dye-sensitized silver halide. The results give further confirmation of the theory previously proposed by the authors for the photovoltaic effect with silver-silver halide electrodes. It is again shown that this effect can be analysed into an initial photoelectronic effect, produced by photoelectrons released from the silver halide passing into the silver metal, and a relatively delayed chemical effect, viz., the reaction of halogen with the silver. This latter process produces an e.m.f. opposing the primary effect. The results, at present, do not permit a conclusion as to whether the electrons are initially released from the dye by absorption of light and recovered from bromide ions of the crystal (with release of Br_2), or whether the dye merely transmits sufficient energy to the crystal to separate electrons and halogen. [For Part II see Abstract 1243 (1930).] AUTHORS.

1679. Photo-e.m.f. in photo-elements of the metal-semiconductor-metal type. Part VI. G. MÖNCH. *Ann. d. Physik*, **36,** 6, *pp.* 557–566, *Nov.*, 1939.—Observations of the photo-e.m.f. with natural and pure synthetic crystals of Cu_2O have given contradictory results [see Abstract 917 (1940)]. (a) At room temperatures cuprite gives a photo-e.m.f., but not pure Cu_2O crystals. (b) If the effect, like the thermo-e.m.f., depends on the diffusion of electrons then both effects should have the same sign whereas in cuprite they are opposite. (c) At low temperatures an effect occurs with pure Cu_2O of the same sign as the thermo-e.m.f. From the collected value of photo and thermo-e.m.f.'s for different substances two classes may be distinguished: (1) Those materials (pure insulating crystals) in which the sign of the thermo and photo-e.m.f.'s are similar. In such cases their photo-effect is termed the " normal photo-e.m.f. " of the internal photo-electric effect, (2) those crystals (minerals) showing more complex behaviour. From a previously derived equation for the thermo-e.m.f. a relation for the photo-e.m.f. is given. J. B. W.

See also Abstract 1647.

PIEZO-ELECTRICITY.

1680. Wave propagation in shearing h.f. quartz oscillators. E. W. SANDERS. *J. of Applied Physics*, **11,** *pp.* 299–300, *April*, 1940.—Experimental verification of a theory of edge grinding is given by demonstrating the presence of elastic waves along the X axis of a low frequency-temperature coefficient quartz plate. AUTHOR.

THERMIONICS.

1681. Anode effect as function of temperature. P. L. Copeland. *Phys. Rev.*, **57,** *pp.* 625–634, *April* 1, 1940.—The anode effect [see Abstract 912 (1936)] has been investigated as a function of temperature first with a diode in which the plate could be separately heated and then with a triode in which a grid maintained at a controlled temperature could be charged by passing an electron current to it. The results indicate : (1) that with the grid at or near room temperature, its surface charge may be high enough to shift its effective contact potential by as much as 2 or 3 V, and (2) that the magnitude of the surface charging decreases rapidly with temperature, being limited to about 0·1 V at 600°K., and not being detected at all above 675°K. Time studies for the drift of contact potential were made. It was found that if the contact potential shift was plotted against the logarithm of the time, the resulting graphs were nearly linear. This fact suggests that the drifts involve groups of electrons with different binding forces ; so that the effective time constant of the discharge of the surface varies continuously during the history of the drift. Author.

1682. Thermal ionization of barium. B. N. Srivastava. *Roy. Soc., Proc. A*, **175,** *pp.* 26–35, *March* 28, 1940.—In this paper a new method has been described for experimentally studying the thermal ionization of gases. The apparatus used has already been described in detail by Saha and Tandon elsewhere. Thermal ionization of Ba vapour has been investigated at various temperatures and the equilibrium constant and the effective energy of ionization have been calculated. The results obtained agree, within the limits of experimental error, with the theory of thermal ionization. The results also support the usual interpretation of the well-known Ba anomaly in the solar spectrum, and yield for the effective ionization energy at 1 500°C. a value of 114·1 kg.cal., though the ionization potential of Ba is 5·19 V corresponding to 119·5 kg.cal. The theoretical value for this quantity at 1 500°C. is 114·4 kg.cal. Author.

1683. Thermionic emission, migration and evaporation of Ba on W. J. A. Becker and G. E. Moore. *Phil. Mag.*, **29,** *pp.* 129–139, *Feb.*, 1940.—Data here given show that some regions of a W filament require more than 5 times as much Ba as others for optimum emission. The rates of both migration and evaporation depend on the crystal surface, the temperature and the amount of Ba on the surface. Ba migration on W can be observed at temperatures as low as 970°K., is readily observed at 1 025°K. and is rapid at 1 070°K. Evaporation is observed on some crystals at temperatures as low as 1 025°K., while on others it is slow even at 1 260°K. At 1 300°K. it is rapid for all crystals. These temperatures probably vary with the oxygen contamination which comes over to the filament with the Ba. For Ba concentrations near the optimum there exists a range of temperature over which migration is readily observed, but where evaporation is not noticeable. Measurements of electron emission after all the Ba is evaporated show that the filament is contaminated by an electronegative material, probably oxygen. Ba tends to migrate towards the negative end of the filament, thus indicating ionization of adatoms. A. W.

THERMO-ELECTRICITY.

See Abstract 1679.